SBW Consulting, Inc.
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Impact and Process Evaluation of the 2001 Commercial Water Conservation Programs

Volume 1

Program Evaluation Report

Submitted to

Saving Water Partnership
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Marc Schuldt, Bing Tso and Randy Birk performed engineering data collection and analysis for this study. Michael Baker was responsible for sample design and selection. Linda Dethman and her associates were responsible for the development and administration of decision-maker interviews and the analysis of responses from those interviews. Marc Schuldt, Michael Baker, Bing Tso and Linda Dethman authored this final report. Members of SPU staff (Hans Van Dusen, Phil Paschke, Jenna Smith and Tim Skeel) provided guidance on study objectives, information on program participants, and review comments on all the products of this evaluation.

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Executive Summary

The Water Smart Technology program, including the Water Efficient Irrigation program (referred to jointly in the balance of this report as "the program") provides incentives and technical assistance for commercial, institutional (including multifamily common laundries) and industrial customers of any size. These may be customers served directly by SPU or by one of SPU's 26 water purveyors. Specific incentives are offered for a number of technologies, such as efficient coin-op washing machines, efficient toilets and urinals and replacement of water-cooled ice machines with air-cooled ice machines. In addition, custom incentives are available for other types of water savings measures. The program also provides outreach and technical assistance to support conservation activity without rebates.

For incentives, customers complete an application prior to installing a measure, which includes an estimate of the savings that will be achieved. SPU may assist in identifying feasible measures, often through audits performed in collaboration with Seattle City Light and the Business and Industry Resource Venture, and may provide assistance in estimating savings for a measure. Each applicant receives written confirmation that the measure has been approved or not approved. All approved applications receive a statement declaring the amount of the incentive that will be provided. A few incentives are based on actual performance measured by SPU after installation of the measure is complete. Incentives are paid after a post-installation inspection of the measure confirms that it has been installed as planned and is providing the expected savings. For this evaluation a program participant was defined as a SPU customer that had applied for and was qualified to receive an incentive under the program, and installed at least one measure by February 28, 2002 that was inspected and deemed to be complete by SPU.

Objectives of the 2001 Program Evaluation

The objectives of this evaluation were as follows:

1. Estimate the gross and net savings achieved by projects completed under the program in 2001.

2. Compare the evaluation estimate of savings to the estimate prepared by the program and determine the reasons for major differences. Based on this analysis recommend improvements to the program's procedures for estimating savings.

3. Determine how well the program is operating from the viewpoint of participants and non-participants. Identify ways that it can better meet its goals and objectives.

4. Determine the level of customer satisfaction with and awareness of the program and provide information that can help SPU predict likely levels of future program participation, which types of customers are most likely to participate, and methods for increasing participation.

Impact Evaluation Methodology

The data collection and analysis methods used to assess gross water savings were developed to provide consistent and site-specific treatment to each efficiency measure, yet be flexible enough to adapt to the specific circumstances encountered at each site and to budgetary constraints. A key element to this approach was the development of a measure-specific evaluation plan after an initial site visit. Each plan documented the data collection and analysis methodology that was used to compute separate estimates of annual water consumption for the baseline and efficient conditions. Water savings from each efficiency improvement were computed as the difference between the annual estimates of baseline and efficient

consumption, after adjustment was made for variations in seasonal performance, production variations or other factors that influenced water consumption but were not related to the performance of the measure.

For each technology, the preferred approach to evaluating gross savings was the direct measurement of baseline and efficient water consumption. However, direct measurements were not practical in some cases, so alternative approaches were developed to estimate savings based on other site-specific sources of water system performance data.

A sample of 25 measures were randomly selected from those installed under the program in 2001 and early 2002. Measure-specific evaluation plans were carried out for this sample, resulting in evaluation estimates of gross savings. These evaluation estimates were compared to those prepared by program staff and the reasons for major differences were identified. Both sets of estimates were used to develop savings realization rates for measures grouped by water efficiency technology, e.g., single-pass cooling improvements. These realization rates were applied to program savings for all projects completed in 2001 to develop estimates of program-level gross savings.

Interviews with participant decision-makers were conducted for each of the 25 measures. Data from these interviews were used to evaluate the impact of free-ridership and spillover, ultimately resulting in a net-to-gross ratio (NTGR) for each measure. The NTGR was used to estimate net savings for each measure and subsequently for each water efficiency technology and for the program as a whole.

Major Findings of the Impact Evaluation

The table below shows the evaluation estimate of gross savings for each water efficiency technology category and for the program as a whole. The lowest gross realization rate was for urinals (52%). The highest gross realization rate was for tank type toilets (186%). The result for process technology is mostly determined by one very large measure installed at the Todd Shipyards. This measure had a substantial impact on the overall realization rate for the program.

The table also shows the net savings results and the overall program realization rate that accounts for both the gross and net realization rates. When both gross and net realization rates were applied, an estimate of 127,241 CCF/yr for the 2001 program was derived. This is 86% of the program staff's estimate of savings for the program.

Exec - 1: Evaluation Estimate of Program Gross and Net Savings

End Use / Water-Efficiency Technology	Program Staff Savings (CCF/yr)	Gross Realization Rate (%)	Evaluation Gross Savings (CCF/yr)	Net-to-Gross Ratio (%)	Evaluation Net Savings (CCF/yr)	Program Realization Rate (%)
Process						
Washing Machine Coin-Op	2,705	182%	4,929	70%	3,450	128%
Refrigeration / Ice Machines	17,474	88%	15,339	61%	9,308	53%
Single-Pass	12,401	56%	6,910	37%	2,563	21%
Process Water	12,954	57%	7,378	40%	2,965	23%
Other Technology	39,405	179%	70,378	89%	62,958	160%
Tank Type Toilets	4,475	186%	8,318	47%	3,933	88%
Flush Valve Toilets	2,925	76%	2,222	60%	1,333	46%
Urinals	7,164	52%	3,725	29%	1,087	15%
Irrigation	49,132	88%	43,390	91%	39,644	81%
All End Uses and Technologies	**148,636**	**109%**	**162,588**	**78%**	**127,241**	**86%**

Process Evaluation Methodology

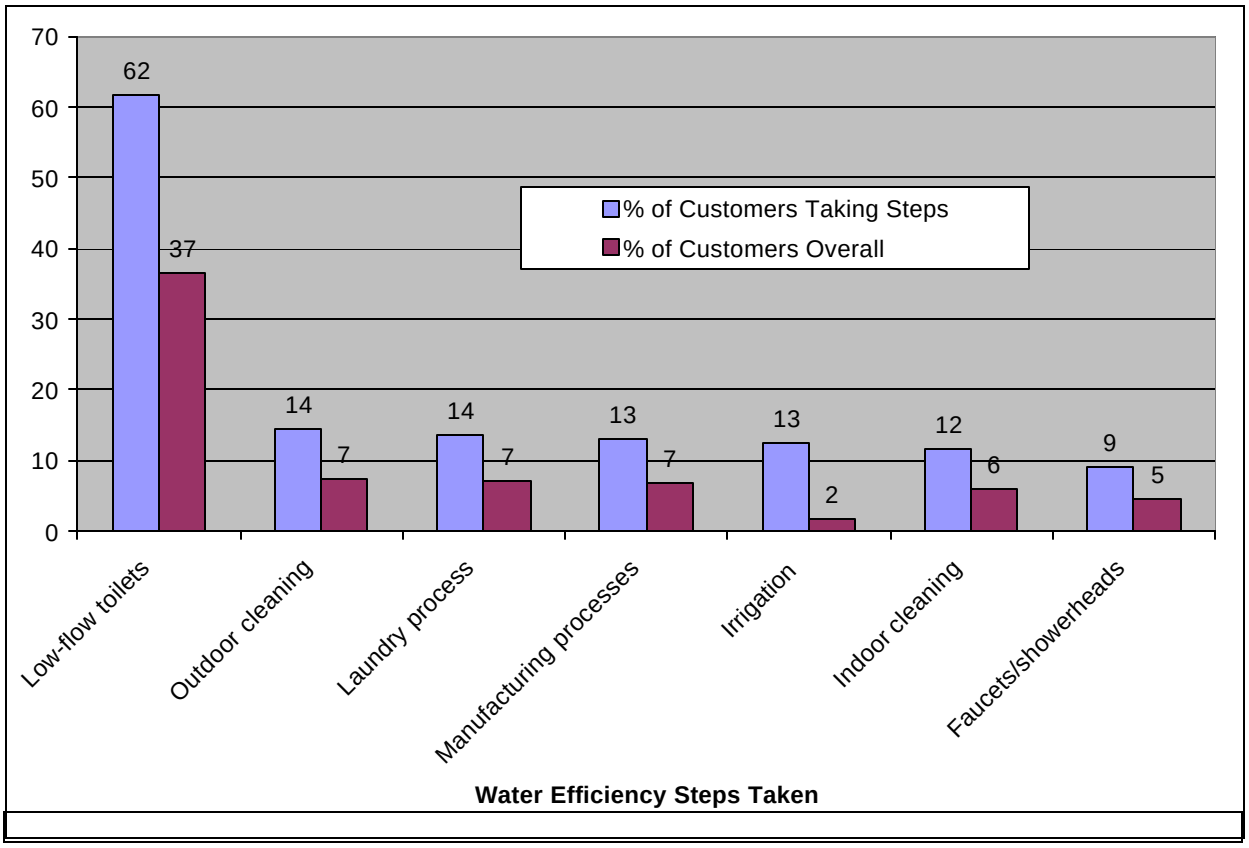
The purpose of the process evaluation was to assess customer awareness and interest in the program; marketing effectiveness; market conditions, e.g., water saving opportunities and activity; customer satisfaction with the program; program design issues; and program influence beyond measure installation, i.e., "spillover."

The assessment combined data gathered in telephone interviews with decision-makers associated with the impact evaluation sample of participants (20 organizations that installed 25 water saving measures); a panel of baseline (N=133) and follow-up (N =78) interviews with appropriate decision-makers from the population of commercial customers; in-person interviews with program staff; and a review of program materials.

Process Assessment of the Program

- General awareness of **any** utility sponsored water conservation program targeted to commercial customers did not increase significantly over the year, remaining at about one-third of the population; program name recall was very low. While the single strongest suggestion from program participants was to improve and expand program marketing, it is also notable that half of customers reported they have little opportunity to save -- i.e., "just a sink and a toilet." Thus, target marketing is key to the program's success.
- In 2001, the program targeted large customers and customers from the hospitality, medical, educational, and institutional sectors. Although general awareness did not change overall, significant increases in general awareness did occur for large customers, hotels, and medical facilities. Awareness levels, however, did not change or decreased for restaurants (unchanged at about 45%) and educational facilities (decreased from 61% to 42%). Participant observations support that more outreach is needed for these two targets.
- Opportunity for savings still exists among the five current target markets and two additional target markets: manufacturers and mixed-use buildings. Organizations within all these segments are the most likely to be very interested in participating.
- A review of 132 measures that received incentives (123 measures for 2001 and the 9 measures from 2002 sampled for the impact evaluation) shows most of the 79 indoor measures (65%) were installed in the targeted segments. Of these indoor measures, 25% were installed in schools; 28% in hotels and restaurants; 6% in medical and dental facilities; and 6% in large or institutional facilities. Most of the 53 irrigation measures (81%) were installed in institutional playgrounds, parks, and community centers. While the target marketing is clearly working, the "depth" of awareness within target segments may still not be very great (for instance, most measures installed in educational facilities were within two organizations).
- The program objective of being "vendor-driven" was partially realized: program participants primarily became aware of the program either through direct utility marketing (35%) or through vendors (30%).
- Water saving activity nearly doubled in 2001 compared to the prior two years; 58% of respondents to the follow-up survey reported they had taken at least one action to save water. The incidence of steps taken is shown in the graph below. Toilet replacement clearly outstrips other actions, but many other types of actions were also taken. A very small proportion (4%) of customers credited their water utilities with helping them take these steps. The drought alert and the weaker economy likely had more direct influence on the rise in activity. (Steps taken by less than 5% of customers are not shown.)

Exec - 2: Incidence of Water Efficiency Actions Taken in 2001



- Participant satisfaction ratings were high for most program elements; three quarters of participants said they were very satisfied with the overall program, communication of program benefits, program requirements, the required paperwork, and the project approval process. 80% of respondents did not experience any barriers to participating in the program.
- While most participants were satisfied with the rebate level, 80% of the measures would have still been installed if the incentive had been 50% less. In addition, for 44% of the measures, participants reported that they would have been very likely to install the measures without the program. In these cases, failed equipment, existing replacement budgets, or obvious cost-effectiveness spurred the change to greater efficiency.
- For 40% of the measures, participants may or may not have installed them without the program. For these measures, participants were clearly influenced by the rebate and other assistance, but also by the need to replace equipment. For 16% of the measures, it was very unlikely for the measure to have been installed without program help. For these measures, the improvement usually was too expensive.
- The program experience spilled over into other parts of the organization, with 70% of respondents saying participation fostered greater organizational water efficiency; 60% reporting they planned additional water saving actions outside the program; and 15% reporting they had already taken some further actions outside the program.

Strategies for Improving the Program

- To improve the gross savings realization rate, verify water savings for all measures estimated to have savings greater than 1,000 CCF/yr. The verification would include baseline measurements

in all cases and post-installation measurements, when appropriate. In the 2001 program, 26% of the measures met this criterion and they accounted for 83% of the program staff estimate of savings for the program. All or a portion of the incentive should be dependent upon the results of the verification.

- To reduce errors in the program-tracking database, redesign the form used to document savings from approved customer applications. This form should require separate estimates of savings for each distinct measure covered by the applications. The form should also standardize the units for the final savings number, e.g., GPD or CCF/yr. Improved quality control procedures for the entry of the measure savings into the program-tracking database would be helpful. Specifically, have two people independently check each entry.
- Create a written log of interactions between customers and SPU program staff after a customer expresses interest in program participation. This log should clearly document all interactions that the program has with the customer regarding water conservation actions in both the short term and long term. This log will create a customer history that will be very helpful to both future marketing efforts and program evaluations.
- Review the savings calculation methodologies being used by the program, in light of program evaluation results. Update the methodologies to reflect the measured results and analysis methods, with particular attention to measures with low realization rates.
- To reduce free-ridership:
  - Ask customers to verify that they have not placed an order or received any of the parts or equipment needed to implement a proposed measure. Make it a clear qualification requirement, i.e., in marketing materials, workshops with customers, and with vendors, that such ordering or receipt not take place prior to approval of the customer's application for an incentive.
  - Work with vendors to determine how to increase use of the program as an up-front sales tool rather than as a "bonus" after the buyer has already decided to buy the same product.
  - Do not fund measures with less than an 18-month payback, considering water cost savings.
- Consider lowering incentives to stretch program dollars, since for 80% of the 25 measures, participants would have still gone forward if the incentive had been cut in half. Although the numbers are small by type of measure, lower incentives would have worked for all low-flow toilets (3 of 3) and urinals (2 of 2); irrigation control systems (2 of 2); water pumps (2 of 2); ozone laundry systems (2 of 2); and the cooling system (2 of 2). Lower incentives would also have been acceptable for 3 of 5 air-cooled ice machines.
- Develop a written set of goals and objectives for program performance aside from savings impacts. Then develop a set of measurable indicators to track progress. For the program, indicators might specify goals for participant satisfaction; level of vendor involvement in program promotion; level of strategic partnerships; evidence of effective target marketing; and service to purveyor areas. For the overall customer population, indicators might include evidence of changes in customer knowledge and awareness of the program; attitudes about conservation; and conservation actions taken.
- Where needed, expand process evaluation efforts to address the indicators adopted. For instance, if vendor and trade partnerships are central strategies to program success, include interviews with key partners or a survey of appropriate vendors. Use these findings to better understand and improve vendor involvement and trade partnership relationships.
- Expand success indicators to include lower levels of free-ridership; changes in customer behavior

(spillover); and increased market share of water efficient equipment.

- If not currently being done, gather marketing information through the program application or initial contact with the customer and include it in the program database. This data can then be accessed for evaluation purposes. Items to include are the organization's market segment (note: codes need to correspond to defined targets such as hospitality, medical); how the applicant found out about the program; and whether or not a vendor was involved.
- Continue marketing to current market segments, but improve or increase efforts for restaurants and educational institutions, e.g., primary and high schools, and add manufacturing and mixed-use buildings as specific targets. Give more emphasis to the program name so that customers have a "short-hand" reference to the program and can pass it along to other organizations.

1 Introduction

1.1 Overview of the Program

The Water Smart Technology program, including the Water Efficient Irrigation program (referred to jointly in the balance of this report as "the program") provides incentives and technical assistance for commercial, institutional (including multifamily common laundries) and industrial customers of any size. These may be customers served directly by SPU or by one of SPU's 26 water purveyors. Specific incentives are offered for a number of technologies, such as efficient coin-op washing machines, efficient toilets and urinals and replacement of water-cooled ice machines with air-cooled ice machines. In addition, custom incentives are available for other types of water savings measures. The program also provides outreach and technical assistance to support conservation activity without rebates.

For incentives, customers complete an application prior to installing a measure, which includes an estimate of the savings that will be achieved. SPU may assist in identifying feasible measures, often through audits performed in collaboration with Seattle City Light and the Business and Industry Resource Venture, and may provide assistance in estimating savings for a measure. Each applicant receives written confirmation that the measure has been approved or not approved. All approved applications receive a statement declaring the amount of the incentive that will be provided. A few incentives are based on actual performance measured by SPU after installation of the measure is complete. Incentives are paid after a post-installation inspection of the measure confirms that it has been installed as planned and is providing the expected savings. For this evaluation a program participant was defined as a SPU customer that had applied for and was qualified to receive an incentive under the program, and installed at least one measure by February 28, 2002 that was inspected and deemed to be complete by SPU.

1.2 Objectives of the 2001 Program Evaluation

The objectives of this evaluation were as follows:

1. Estimate the gross and net savings achieved by projects completed under the program in 2001.

2. Compare the evaluation estimate of savings to the estimate prepared by the program and determine the reasons for major differences. Based on this analysis, recommend improvements to the program's procedures for estimating savings.

3. Determine how well the program is operating from the viewpoint of participants and non-participants. Identify ways that it can better meet its goals and objectives.

4. Determine the level of customer satisfaction with and awareness of the program and provide information that can help SPU predict likely levels of future program participation, which types of customers are most likely to participate and methods for increasing participation.

1.3 Overview of Evaluation Methods

Both impact and process evaluation methods were used in this study. The impact evaluation methods provide the information and analyses needed to achieve the first two objectives cited above. The process evaluation accomplishes the other two objectives.

1.3.1 Impact Evaluation

The data collection and analysis methods that were used to assess gross water savings were developed to provide consistent and site-specific treatment to each efficiency measure yet be flexible enough to adapt to the specific circumstances encountered at each site and budgetary constraints. A key element to the consistent and cost-effective treatment of each sampled measure was the development of a measure-specific evaluation plan after an initial site visit. Each plan documented the data collection and analysis methodology, considering site-specific conditions and budget allocations. All plans documented the procedures that were used to compute separate estimates of annual water consumption for the baseline and efficient conditions. Water savings from each efficiency improvement were computed as the difference between the annual estimates of baseline and efficient consumption, after adjustment was made for variations in seasonal performance, production variations or other factors that influenced water consumption but were not related to the performance of the measure.

For each technology, the preferred approach to evaluating gross savings was the direct measurement of baseline and efficient water consumption. However, direct measurements were not practical in some cases, so alternative approaches were developed to estimate savings based on other site-specific sources of water system performance data.

A sample of 25 measures were randomly selected from those installed under the program in 2001 and early 2002. Measure-specific evaluation plans were carried out for this sample, resulting in evaluation estimates of gross savings. These evaluation estimates were compared to those prepared by program staff and the reasons for major differences were identified. Both sets of estimates were used to develop savings realization rates for measures grouped by water efficiency technology, e.g., single-pass cooling improvements. These realization rates were applied to program savings for all projects completed in 2001 to develop estimates of program-level gross savings.

Interviews with participant decision-makers were conducted for each of the 25 measures. Data from these interviews were used to evaluate the impact of free-ridership[1] and spillover[2], ultimately resulting in a net-to-gross ratio (NTGR) for each measure. The NTGR[3] was used to estimate net savings for each measure and subsequently for each water efficiency technology and for the program as a whole.

1.3.2 Process Evaluation

The intent of the process evaluation was to assess how well the program operated during 2001 in terms of its goals and objectives. It addressed topics such as awareness of, interest in, and likelihood of participating in the program; customer characteristics, attitudes, and actions; satisfaction with the program, outcomes of program efforts; areas of program strengths; and needed program improvements.

The process evaluation was based on data gathered in telephone interviews with decision-makers associated with the impact evaluation sample of participants; a panel of baseline and follow-up interviews with appropriate decision-makers from the population of commercial and industrial customers served by SPU and its purveyors; in-person interviews with program staff; and a review of program materials.

[1] Free-ridership is a measure of the likelihood that a customer would have installed the same measure at the same time even if the program did not exist.

[2] Spillover is a measure of the likelihood that the customer is influenced by the program to implement additional water savings measures beyond those for which an incentive is paid.

[3] Net-to-Gross Ratio is used to adjust the evaluation estimates of gross savings to account for both the free-ridership and spillover effects.

2 Sample Design and Selection

Data for this evaluation came from program materials, telephone and in-person interviews, on-site inspections, and end use metering. This data was collected for a sample of measures installed by program participants. Data was also collected from a sample of organizations selected to be representative of the entire population of SPU's commercial and industrial customers.

2.1 Program Participant Sample

The process of building a list of program participants began with the development of the "Early Warning Spreadsheet." SPU program staff maintained this Excel workbook. They entered measures in this workbook once they felt that there was a good chance the measure would be installed during 2001. We randomly sampled measures throughout the year as they were added to this workbook so that we would have an opportunity to take measurements for the affected water end uses before the efficiency measures were installed. These baseline measurements provided extremely valuable information and greatly improved the reliability of our estimates of savings.

The desire for baseline measurements made the sampling process complicated. In some cases, projects moved forward quickly. By the time we contacted some sites, measure installation was underway or complete and we had lost the opportunity to collect baseline measurements. These measures were replaced with the next available measure on the list. In other cases, projects moved very slowly or dropped out of the program after the evaluation began. We proceeded with baseline data collection but then SPU had to estimate whether they would be installed in time for us to collect post-installation measurements and prepare savings estimates for this evaluation. In ten instances, the installation did not occur at all or in time to be used for this evaluation. An unavoidable consequence of the real time sample selection used in this study is that some measures will be dropped after work begins on baseline data collection. The only way to avoid this problem is to select the sample after the program year ends and you know for sure what measures were installed. Unfortunately, that design makes it impossible to take baseline measurements.

Our original design was to only include in this sample measures that were installed and inspected by the end of 2001. However, SPU extended the deadline until February 28, 2002 in order to keep as many sampled measures in this evaluation as possible, to support the calculation of the gross realization rate.

Measures were sampled from each of the following water efficiency technology categories:

1. Washing machine coin-op
2. Refrigeration / Ice Machines
3. Single-Pass Cooling
4. Process Water
5. Cooling Towers
6. Other Process Technology
7. Tank Type Toilets
8. Flush Valve Toilets
9. Urinals
10. Irrigation

As the first step in the sample selection process, SPU developed a forecast of the number of measures that would be installed in each of these categories during 2001. The number of measures forecast for the category and the number that were desired in the final sample determined the frequency of sampling. For example, consider the Single Pass technology. SPU expected 11 of these projects and wanted to complete evaluations for a sample of six. We selected the first project in the list and then selected every other project. As expected, the forecast was not exactly correct. We made a mid-year correction to the forecast and adjusted the sampling frequencies. As part of this correction, we eliminated any sample from the Cooling Towers category because SPU expected only one project.

Data collection and analysis were completed for 25 measures. This sample was distributed as shown in the table below among the water efficiency technology categories. Also shown in the table is the program staff savings estimate for measures completed in 2001 and for the sample. Nine measures in the sample were completed after the end of 2001, so only 16 of the 25 sampled measures are among the 123 measures shown as completed in 2001.

Table 1: Participant Sample Size and Savings Estimate

	Measures Completed in 2001		Measures in Sample		
End Use / Water-Efficiency Technology	Number of Measures	Program Staff Savings Estimate (CCF/yr)	Number of Measures Completed in 2001	Number of Measures	Program Staff Savings Estimate (CCF/yr)
Process					
Washing Machine Coin-Op	5	2,705		1	174
Refrigeration / Ice Machines	20	17,474	5	8	13,395
Single-Pass	9	12,401	4	5	7,700
Process Water	5	12,954	1	2	3,805
Other Technology	3	39,405	2	2	26,757
Tank Type Toilets	13	4,475	2	2	640
Flush Valve Toilets	3	2,925		1	2,225
Urinals	12	7,164		2	6,268
Irrigation	53	49,132	2	2	3,242
All End Uses and Technologies	**123**	**148,636**	**16**	**25**	**64,206**

2.2 Population Baseline and Follow-up Samples

We collected data at the beginning of 2001 and again at the beginning of 2002 from a second sample, representative of all SPU and purveyor commercial and industrial customers. This allowed us to detect the impact of the 2001 program on attitudes of all customers.

As of December 31, 2000, all customers of SPU and its purveyors were non-participants in the 2001 program. Ideally, we would have built a list of all customers as of that date. However, each of the purveyors maintains their own customer databases and it takes a substantial amount of time and effort to build a consolidated list. In addition, SPU and its purveyors maintain customer databases at the account level and account information generally does not include phone numbers or contact names. Also, many organizations have multiple accounts, serving one or more buildings at one or more locations. For this evaluation we wanted to obtain information about organizations, not accounts, and gather information about their water end uses and attitudes concerning water conservation.

A major commercial water use survey was completed by SPU in 1996. A consolidated list of customer accounts was created at that time to serve as the sample frame for that survey. A large stratified random sample was drawn from that frame and substantial time was devoted to gathering contact information for the sample and identifying the accounts that belonged to each unique organization. Although there have been some changes in the customer base since 1996, SPU determined that the annotated sample list from the 1996 survey was sufficiently current to act as the sample frame for this study.

It is important to keep in mind that this frame is representative of the entire commercial customer population (except multifamily) eligible for the program at the beginning of 2001. Customers in this frame run the gamut in terms of their involvement with the program, including:

- Organizations that have never heard of the program
- Organizations that have some awareness or involvement with the program but have not pursued projects
- Organizations that have completed projects with the program in prior years but that did not pursue projects in 2001
- Organizations that implemented projects in 2001.

Table 2 shows the number of accounts in each stratum of the population for the stratified design used in the 1996 survey. Accounts for multifamily buildings were included in the original frame but were excluded from the frame for this evaluation. Customer size increased with stratum number.

The number of organizations interviewed in the baseline and follow-up surveys is shown for each sample stratum. In total, 143 organizations were interviewed in the baseline survey and 78 were interviewed in the follow-up survey. Some organizations had accounts that fell into more than one stratum. Responses for those organizations were assigned to the stratum of the account with the highest water use and interviews were conducted for the building or facility associated with the account in the highest use strata. This assumed that, because the organization had an account with high use, its attitudes were more similar to other organizations with high use accounts. For example, if a golf course had an account for the clubhouse and one for irrigation and the irrigation account was in strata 9 and the clubhouse account was in strata 2, the responses from this organization were assigned to strata 9. If the clubhouse and irrigated course were at the same general location, information on water use was gathered for the whole facility at that location. If, however, this organization also had an office building for its administrative purposes, but it was not at the same location, water uses were not gathered for the office building.

The survey team called through the entire list (excluding apartment buildings) of unique organizations within each stratum to complete the baseline survey. Therefore, within a stratum, each organization had a roughly equal chance of providing a response and could be assigned the same sample weight. The follow-up surveys were completed with only a portion of the baseline survey sample, so the sample weights are somewhat larger, as shown in the table. These sample weights were used in deriving the estimate of population characteristics from the baseline and follow-up survey responses.

Table 2: Sample Completed for Baseline and Follow-up Surveys

	1996 Customer Population		Baseline Survey		Follow-up Survey	
Strata	Number of Accounts	Average Water Use / Day	Number of Interviews	Sample Weight	Number of Interviews	Sample Weight
1	15,697	4,653	40	392.43	15	1046.47
2	4,703	11,155	40	117.58	30	156.77
3	1,947	29,890	41	47.49	20	97.35
9	58	13,909	22	2.64	13	4.46
Total	**22,405**	**59,607**	**143**		**78**	

3 Impact Evaluation Methodology

The objective of the impact evaluation was to estimate the water savings (CCF/year) attributable to projects completed by the program in 2001. Gross savings were estimated for each of the sampled measures, using an evaluation approach that was consistent with the project evaluation plan. In addition, net savings were estimated by adjusting the gross savings for free-ridership and other effects. This section of the report summarizes the specific data collection efforts and savings analyses that were performed for each of the sampled measures. In addition, it describes how these individual measure estimates were adjusted for free-ridership and spillover and how program-level estimates of gross and net savings were developed.

3.1 Description of Sampled Measures

Twenty-five water conservation measures were sampled for the impact analysis of gross savings. These measures were installed in 20 facilities in the SPU service area. The sampled measures represented nine of the ten technology categories included in the 2001 program savings. Each of the measures is described below in Table 3. A more detailed description of each measure is provided in the individual measure reports, which are compiled in Volume 3 of this report.

3.2 Overview of Data Collection Procedures

A standard set of data collection procedures were applied to the sampled measures. The procedures supported the consistent and organized collection of information necessary to implement the evaluation approach selected for each measure. The data collection task sequence that was followed for each selected measure is described below:

1. **SPU Contact:** SPU was notified that a measure was selected for the evaluation. SPU contacted the customer and informed them that they were included in the evaluation and that they would be contacted to make an appointment for an initial site visit. The evaluation proceeded unless SPU notified the study team that the project was removed from the sample.

2. **Project File Review:** SPU provided a copy of the project file that had been compiled for the measure. The file contained the application submitted by the customer, a data base extract and other important information that was compiled by SPU during the review process. The contents of the file were reviewed to get background information on the project and to understand the water efficiency technology that was being installed.

3. **Determine Data Requirements:** A determination was then made of the data elements that had to be collected to support the estimation of water savings. For each data element, a specific data collection or measurement technique was also determined. All equipment and materials necessary to perform the site visit were assembled in preparation for the site visit.

4. **Conduct Site Visit (Stage 1):** The initial or stage 1 site visit was scheduled with the site contact and an SPU representative, when applicable, at a time that was mutually agreeable. In the initial visit, the feasibility of the measure for evaluation purposes was assessed by investigating the following:

    - **Data collection barriers** - Assessed physical barriers that would prevent affordable data collection, such as lack of exposed water piping. Also assessed access barriers, such as owner or tenant permission, time-of-day equipment installation constraints, and customer willingness to allow measurement equipment to be installed.

Table 3: Descriptions of Sampled Measures

End Use / Technology	ID#	Facility Name	Measure
PROCESS			
Washing machine coin-op	WM002	KC Housing Authority	17 horizontal-axis washing machines replacing vertical-axis units at 3 public apartment complexes.
Refrigeration/ Ice Machines	RIM002	U of W Student Union Building	Evaporative cooling system instead of single-pass cooling for student building refrigeration compressors.
	RIM017	Pike Place Fish	Air-cooled ice machine replacing 6800-lb single-pass water-cooled unit at retail fish market.
	RIM018	Wild Salmon Seafood Market	Air-cooled ice machine replacing 1000-lb single-pass water-cooled unit at retail fish market.
	RIM020	Lake Washington School District	Three air-cooled ice machines replacing 320-645-lb single-pass water-cooled units at 3 secondary schools.
	RIM021	Meydenbauer Center	Closed loop cooling system replacing single-pass water cooling for four refrigeration compressors at a convention center.
	RIM022	Meydenbauer Center	Closed loop cooling system replacing single-pass water cooling for a 580-lb ice machine at a convention center.
	RIM023	Town Center Mini-Mart Texaco	Replace 1250-lb single-pass water-cooled ice machine with air-cooled unit at convenience store.
	RIM025	Lake Washington School District	Replace 2 single-pass water-cooled refrigeration condensers with air-cooled units at 2 secondary schools.
Single-Pass	SPC001	McKenny Dental Offices	Dry vacuum pump replacing 2 liquid ring pumps at dental office.
	SPC004	UW - Tubby Graves Building	Split-system air conditioner replacing single-pass water-cooled unit in computer room.
	SPC005	Standard Steel	Air-cooled air compressor replacing single-pass water-cooled unit at steel fabrication facility.
	SPC006	U of W Student Union Building	Evaporative cooling system instead of single-pass cooling for student building air conditioning unit.
	SPC011	Dr Barrett	Dry vacuum pump replacing liquid ring pump at dental office.
Process Water	PW003	Hilton Seattle	Ozone generator to reduce laundry cycle water requirements at hotel.
	PW005	Renaissance Madison	Ozone generator to reduce laundry cycle water requirements at hotel.
Other Technology	OT002	Todd Pacific Shipyards	Saltwater pumping system replacing city water for shipyard maintenance tasks.
	OT004	1001 Fourth Avenue Plaza	Domestic water booster system in high-rise office to eliminate water bleedoff requirements.
DOMESTIC			
Tank Type Toilets	TTT002	Best Western Executive Inn	58 low-flush tank-type toilets replacing less efficient units in hotel.
	TTT008	Nyconco Development Corp.	42 low-flush tank-type toilets replacing less efficient units in 6 apartment buildings.
Flush Valve Toilets	FVT005	Norton Building	114 low-flush valve-type toilets replacing less efficient units in high-rise office building.
Urinals	UR004	Lake Washington School District	72 low-flush urinals replacing less efficient units with automatic flush controls at 5 elementary and 1 jr. high school.
	UR006	Norton Building	34 low-flush urinals replacing less efficient units in high-rise office building.
OUTDOOR			
Irrigation measures	IRR003	The Seattle Times, Bothell	Computerized irrigation controls replacing manual timeclock system serving 14 landscaped acres at newspaper production facility.
	IRR008	Hawthorne Square	Improved irrigation controls and zoning of 0.7 landscaped acres at condominium complex.

- **Expected installation date** - Determined the anticipated installation date of the water efficiency measure. If the date was so soon that reasonable baseline data could not be collected, the customer was asked to consider a delay in the installation schedule to allow for a longer baseline data collection period.

- **Cost of equipment installation**- Assessed the cost (equipment and labor) for installing the measurement equipment necessary to support the selected evaluation approach. If site-specific circumstances indicated a higher than expected measurement cost or otherwise prevented the selected approach from occurring, then a secondary evaluation approach was formulated.

- **Device inventory**- Created an inventory of all affected devices, which included available nameplate information (relevant to water usage), a count of devices by location and expected operating schedule.

5. **Select Evaluation Approach:** Based on the application review, a suitable evaluation approach was selected for evaluating gross savings for the measure. The selection was based upon knowledge from the application review, site visit and available resources. The approach was selected from the general alternatives described in the project evaluation plan, and adjusted for the specific circumstances encountered for the selected measure.

6. **Write Measure-Specific Evaluation Plan:** Using the information collected during the Stage 1 site visit, a measure-specific evaluation plan was prepared, which described the water efficiency measure, the measure-specific evaluation methodology that was to be employed and the estimated cost to implement the plan. For measures with large numbers of affected devices, the evaluation plan also described the sampling strategy that was used to select a representative subset of devices for data collection and the method that was used to extrapolate the results from this subset to the entire population. The plans were reviewed and approved by SPU.

7. **Conduct Site Visit (Stage 2):** Additional site visits were conducted as necessary to implement the data collection specified in the final measure-specific evaluation plan. During these visits, a variety of data collection activities occurred, such as measurement equipment installation, retrieval and removal; observations of system performance; and collection of operator logs or maintenance records. If required by the evaluation plan, site visits occurred periodically throughout the baseline and post-retrofit data collection periods.

8. **Track Installation Progress:** For measures that required it, the site contact was contacted periodically during the baseline period to receive an update on the status of the measure installation. As the installation approached, preparations were made to end the baseline measurements and begin the post-installation measurements.

9. **Prepare for Data Analysis:** As the data was collected, it was subjected to a quality control review to be sure that the data was complete and reasonable. If problems with the data were uncovered, the affected measurements or observations were corrected or repeated as necessary.

3.3 Measure-Specific Methods for Gross Savings Analysis

After all baseline and post-installation data were collected and found to be of acceptable quality, an estimate of annual water savings was prepared for each water-efficiency measure. To the extent possible, the analysis followed the evaluation approach selected during development of the measure-specific evaluation plan. If unusual or unexpected measure performance was encountered, adjustments to the

approach were made as necessary to provide the best possible estimate of the annual water savings achieved by the project during the post-retrofit year.

The site-specific analysis methods were derived from one of the technology-specific approaches described in the evaluation plan[4]. The preferred savings evaluation approach for all technologies was submetering of water usage (i.e., the installation of a water meter) for each device affected by the water efficiency measure. As appropriate, water consumption was measured before and/or after the installation of the water efficiency measure. The duration of the metering varied, depending on the variability of the flow, the magnitude of the expected savings, and customer constraints. The desired metering duration was suitable for supporting an accurate annual extrapolation. If the period available to collect water consumption data was not long enough to support an accurate extrapolation, then other performance and production data were collected instead, and these used as proxy variables to support estimating annual water consumption. As necessary, additional adjustments were made to account for seasonal variations in occupancy and water supply temperatures.

The evaluation approaches used for each of the 25 measures included in the impact evaluation are summarized in Tables 4 and 5. The table shows that a consistent approach was generally used for all measures within each of the nine technology categories that were evaluated. These approaches are discussed in more detail below:

3.3.1 Gross Savings Evaluation Approaches

3.3.1.1 Washing Machine Coin-op

- Installed flowmeters to measure cumulative water usage over several weeks for all baseline and efficient washers installed under the measure.
- Obtained revenue data from the washer operations contractor for the period corresponding to the usage measurements. Calculated the number of loads washed.
- Calculated water savings per washer load.
- Extrapolated calculated savings per washer load to annual savings, using one year of historical revenue data.

3.3.1.2 Refrigeration / Ice Machines

- Installed flowmeters and/or measured volume and corresponding elapsed time for several minutes to several months, as appropriate for the measure.
- Installed run-time loggers on compressor motors and/or interviewed customer staff to obtain sufficient information for the annual extrapolation.
- Adjusted baseline flowrates to account for variations in water supply temperatures throughout the year.
- Calculated annual baseline usage, which equaled savings.

For two measures, the baseline condensers/machines had already been removed prior to the evaluation. The approach in these cases was as follows:

[4] The final version of the report titled *Impact and Process Evaluation of the 2001 Commercial Water Conservation Programs*, issued by SBW Consulting, Inc. on March 16, 2001.

- Estimated baseline usage using flow and cycle measurements from similar devices.
- Performed post-installation logging of compressor run times.
- Obtained manufacturers' rated operational parameters for baseline and efficient machines to project post-installation performance back to the baseline condition.

3.3.1.3 Single-pass

For the dental vacuum pump measures, the approach was as follows:

- Took one-time flowrate measurements.
- Installed run-time loggers on compressor motors and/or interviewed customer staff to obtain sufficient information for the annual extrapolation.
- Calculated annual baseline usage, which equaled savings.

For the space cooling measures, the approach was as follows:

- Installed flow meters or took one-time flowrate measurements.
- Installed run-time loggers on compressor motors and/or interviewed customer staff to obtain sufficient information for the annual extrapolation.
- Adjusted flowrates to account for variations in water supply temperatures throughout the year.
- Calculated annual baseline usage, which equaled savings.

For the air compressor waste heat removal measure, the approach was as follows:

- Analyzed billing records and calculated average pre- and post-installation annual usage.
- From customer interview and walk-through observations, estimated non-compressor water usage from bathroom fixtures.
- Subtracted non-compressor usage from pre-installation billed usage to obtain compressor usage.
- Adjusted compressor usage to account for variations in water supply temperatures throughout the year. This baseline usage equaled savings.

3.3.1.4 Process Water

For each hotel ozone laundry system, the approach was as follows:

- Installed flowmeters on a sampling of washing machines to measure cumulative water usage over about a month during pre- and post-installation periods.
- Determined the number of loads and pounds of laundry processed during these periods from production logs or by installing current loggers on the power supplies to a sampling of washing machines.
- Calculated water saved per pound.
- Extrapolated unit savings to year using best available annual occupancy rates.

3.3.1.5 Other Technology

For the shipyard saltwater system, the approach was as follows:

- Obtained regular flowmeter readings for major end uses over the year.
- Collected customer estimates of typical types and durations of ship maintenance operations for a year.
- Extrapolated usage per day per end use to typical year.

For measure that eliminated water pump bleedoff, the approach was as follows:

- Installed flowmeter to measure cumulative water usage for about a week.
- Extrapolated this usage to a year.

3.3.1.6 Tank-type Toilets

- Measured flush volumes for a sampling of both baseline and efficient toilets, and calculated savings per flush.
- Installed flowmeters on a sampling of toilets to measure cumulative water usage over about a month during the post-installation period.
- Divided usage by volume to calculate flush counts.
- Extrapolated flush counts to entire year and whole facility using customer-supplied information, and multiplied by savings per flush to get annual savings.

3.3.1.7 Flush Valve Toilets and Urinals

- Measured flush volumes for a sampling of both baseline and efficient toilets, and calculated savings per flush.
- Installed event loggers on standpipes for all fixtures in one or more sampled bathrooms. These loggers monitored flush timing and counts.
- Extrapolated flush counts to entire year and whole facility using customer-supplied information, and multiplied by savings per flush to get annual savings.

3.3.1.8 Irrigation

- Analyzed historical billing data from dedicated irrigation meter to determine average annual pre-installation usage.
- The alternative approaches used for the two measures were as follows:
- Added billed usage and actual precipitation for each month for which data existed to obtain total monthly irrigation in the pre- and post-installation periods. Compared pre and post averages to determine average percent reduction in total irrigation.
- Predicted new sprinkler zone timer settings, and compared with baseline settings to estimate percentage reduction, then used historical daily rainfall totals and rain sensor evapotranspiration rates to calculate typical percentage of time when sensor will shut off system.
- Applied total percentage reduction in irrigation to average pre-installation annual usage to determine annual savings.

3.3.2 Measurements to Support the Evaluation of Gross Savings

Table 6 summarizes the types and quantities of measurements taken to support the evaluation of gross savings. These measurements fall into six categories:

1. One-time flow or volume - typically taken with a bucket and/or stopwatch.

2. Short-term cumulative flow - performed by the evaluation team with several varieties of in-line flow meters.

3. Billing records - obtained from the utility, and representing long-term cumulative flow measured by an in-line flow meter.

4. Run time or time of use - measured with motor loggers that detect and record whenever a motor is in operation or a solenoid is energized.

5. Flush events - recorded with pulse loggers connected to leads inserted into toilet standpipes. A flush completes the electrical circuit, thereby registering a pulse that can be recorded.

6. Other – obtained other pertinent measurements, such as hotel occupancy data, precipitation data, coin-op laundry revenue data and hotel laundry logs.

All 25 of the sampled measures received one or more of these measurements during the course of the evaluation. Fourteen (56%) of the measures were subject to one-time flow/volume measurements, while 13 (52%) had short-term flow measurements taken. These two types overlapped so that 24 of the 25 (96%) received a flow/volume measurement. The remaining one measure used only utility billing records. A total of three measures total (12%) used billing records, while 10 (40%) made use of run-time/time-of-use metering. The three flush valve toilet and urinal measures each were monitored with flush event loggers. A total of seven (28%) of the measures used other sources of measured data.

3.4 Comparison of Program Staff and Evaluation Estimates of Savings

For each of the sampled measures, the gross savings estimate prepared by the program staff was compared to the estimate of gross savings developed in the evaluation. The respective methodologies were examined and reasons why the two estimates were different were identified. Reasons such as differences in assumed operating hours, performance of the new or old equipment, and differences in assumed operating practices were considered. Reasons for the differences were reviewed across measures within each technology category and an attempt was made to identify general patterns that might lead to improvements in the way that the program estimates savings.

3.5 Evaluation of Net-to-Gross Ratio

Interviews were conducted with the decision-maker associated with each sampled measure. The interviews included questions that were used to assess free-ridership and spillover. A program participant becomes a free rider when they receive an incentive to install a water efficiency improvement, even though they would have installed the same improvement in the same time frame without the help of the program. Program assistance may help the customer decide to act, or help the customer to install equipment more quickly. Spillover occurs when the customer is influenced by the program to implement additional water savings measures beyond those for which an incentive is paid.

Table 4: Evaluation Methodology for Each Sampled Measure

End Use / Technology	ID#	Facility Name	Summary of Evaluation Methodology
PROCESS			
Washing machine coin-op	WM002	KC Housing Authority	(1) Measured washer water usage during pre and post period; (2) used revenue data to calculate corresponding loads; (3) extrapolated savings per load to typical annual load counts to get annual savings.
Refrigeration/ Ice Machines	RIM002	U of W Student Union Building	(1) Measured cooling water usage for several minutes to several months, as appropriate; (2) extrapolated usage to year using measured motor run-time data and/or assumptions from customer interviews, and adjusting for water supply temperature variations. Savings equaled baseline usage in all cases. Special situations noted below:
	RIM017	Pike Place Fish	
	RIM018	Wild Salmon Seafood Market	
	RIM020	Lake Washington School District	RIM020: Baseline ice machines no longer running, so baseline usage estimated assuming equivalent ice production, and results from units similar to baseline ones.
	RIM021	Meydenbauer Center	
	RIM022	Meydenbauer Center	
	RIM023	Town Center Mini-Mart Texaco	
	RIM025	Lake Washington School District	RIM025: Baseline condensing units no longer running, so baseline usage estimated with rated amperage ratios, and results from units similar to baseline ones. Also adjusted usage for annual ratio of school to non-school days.
Single-Pass	SPC001	McKenny Dental Offices	For SPC001 & 11 (dental vacuum pumps): (1) Took one-time flowrate measurements; (2) extrapolated usage to year using measured pump motor run-time data and/or assumptions from customer interviews. Savings equaled baseline usage in both cases.
	SPC004	UW - Tubby Graves Building	For SPC004 & 6 (space cooling): (1) Took flowrate measurements; (2) extrapolated usage to year using measured motor run-time data and/or assumptions from customer interviews, and adjusting for water supply temperature variations. Savings equaled baseline usage in both cases.
	SPC005	Standard Steel	For SPC005 (compressor cooling): (1) Analyzed billing records and subtracted estimated non-compressor usage; (2) extrapolated usage to year using assumptions from customer interviews, and adjusting for water supply temperature variations.
	SPC006	U of W Student Union Building	
	SPC011	Dr Barrett	

Table 5: Evaluation Methodology For Each Sampled Measure (Continued)

End Use / Technology	ID#	Facility Name	Summary of Evaluation Methodology
PROCESS (continued)			
Process Water	PW003	Hilton Seattle	Both projects were hotel laundries. (1) Measured water usage during pre and post period; (2) determined corresponding loads/pounds of laundry from hotel logs or monitoring washer power draw; (3) calculated water saved per pound; (4) extrapolated savings to representative year's laundry production.
	PW005	Renaissance Madison	
Other Technology	OT002	Todd Pacific Shipyards	For OT002, obtained regular flowmeter measurements over year, and used historical data to extrapolate to a typical year. For OT004, measured one weeks' usage and extrapolated to a year. Savings equaled baseline usage in both cases.
	OT004	1001 Fourth Avenue Plaza	
DOMESTIC			
Tank Type Toilets	TTT002	Best Western Executive Inn	(1) Measured pre and post flush volumes; (2) monitored cumulative flows with flowmeters for sampled toilets, then divided by volume to get flush counts; (3) extrapolated flushes to whole facility over year, and multiplied by savings per flush to get annual savings.
	TTT008	Nyconco Development Corp.	
Flush Valve Toilets	FVT005	Norton Building	(1) Measured pre and post flush volumes; (2) monitored flush timing, counts with event logger for all fixtures in sampled bathrooms; (3) extrapolated flushes to whole facility over year, and multiplied by savings per flush to get annual savings.
Urinals	UR004	Lake Washington School	
	UR006	Norton Building	
OUTDOOR			
Irrigation measures	IRR003	The Seattle Times, Bothell	(1) Analyzed historical billing records to get average pre usage, (2) For IRR003, added billed usage and actual precipitation to obtain total monthly irrigation, then compared pre/post months to determine % reduction in total irrigation. For IRR008, predicted sprinkler zone on times and compared with baseline to get % reduction, then used historical rainfall and rain sensor evapotranspiration rate to calculate typical % of time when sensor will shut off system, (3) applied total % reduction to average pre usage to determine annual savings.
	IRR008	Hawthorne Square	

Table 6: Measurements Made for Each Sampled Measure

			Measurement type					
End Use / Technology	**ID#**	**Facility Name**	One-time flow/ volume	Short-term flow	Utility billing records	Run-time, time of use	Flush event	Other
PROCESS								
Washing machine coin-op	WM002	KC Housing Authority	-	1	-	-	-	1
Refrigeration/ Ice Machines	RIM002	U of W Student Union Building	-	1	-	-	-	-
	RIM017	Pike Place Fish	-	1	-	1	-	-
	RIM018	Wild Salmon Seafood Market	1	-	-	-	-	-
	RIM020	Lake Washington School District	1	-	-	1	-	-
	RIM021	Meydenbauer Center	-	1	-	1	-	-
	RIM022	Meydenbauer Center	1	-	-	1	-	-
	RIM023	Town Center Mini-Mart Texaco	1	-	-	1	-	-
	RIM025	Lake Washington School District	1	-	-	1	-	-
Single-Pass	SPC001	McKenny Dental Offices	1	-	-	-	-	-
	SPC004	UW - Tubby Graves Building	1	-	-	1	-	-
	SPC005	Standard Steel	1	-	1	-	-	-
	SPC006	U of W Student Union Building	-	1	-	-	-	-
	SPC011	Dr Barrett	1	-	-	1	-	-
Process Water	PW003	Hilton Seattle	-	1	-	1	-	1
	PW005	Renaissance Madison	-	1	-	-	-	1
Other Technology	OT002	Todd Pacific Shipyards	-	1	-	-	-	-
	OT004	1001 Fourth Avenue Plaza	-	1	-	-	-	-
DOMESTIC								
Tank Type Toilets	TTT002	Best Western Executive Inn	1	1	-	-	-	1
	TTT008	Nyconco Development Corp.	1	1	-	-	-	-
Flush Valve Toilets	FVT005	Norton Building	1	-	-	-	1	1
Urinals	UR004	Lake Washington School District	1	1	-	1	1	-
	UR006	Norton Building	1	-	-	-	1	-
OUTDOOR								
Irrigation measures	IRR003	The Seattle Times, Bothell	-	1	1	-	-	1
	IRR008	Hawthorne Square	-	-	1	-	-	1
Total count			**14**	**13**	**3**	**10**	**3**	**7**
Count as % of all projects			**56%**	**52%**	**12%**	**40%**	**12%**	**28%**

A six step protocol, based upon decisions-maker interview responses, was used to assess the level of free-ridership and spillover for each measure and to derive a Net-to-Gross Ratio. This ratio determines what fraction of the gross savings is attributable to the SPU's program. Given that some scores were based on interpretation of qualitative information, two judges scored each measure independently. The inter-judge reliability was very high; only one scoring discrepancy had to be resolved. In addition, both judges reviewed the scores across the measures and determined that the scores, relative to one another, seemed accurate, i.e., that similar circumstances resulted in similar scores.

This protocol resulted in a score that represents the percentage of gross savings that the measure should be allowed; for instance, a score of 80, out of 100, would mean that the measure would receive 80% of the savings. The protocol steps are described below.

- Step 1: The participant provided a self-report of the organization's free-ridership by answering this question: "On a scale of 1 to 10, how likely would you have been to install the **exact same measure in the same time frame on your own,** without the help of the program?" (Note: Participants have little incentive to inflate the influence of the program because they have already received their incentive.) Participants were also asked to give the reasons for their ratings, to help make sure that the self-rating matched the intent of the scale.
- Step 2: The measure was given a credit of 5% if the organization was participating for the first time. This credit acknowledged that the participant was likely to have learned something new about water efficiency due to the program or was encouraged by the program to take action.
- Step 3: The measure had credits deducted if equipment was bought in advance (-25%) or installed (-50%) before submitting a program application. These actions both indicated that the organization would have installed the measure at the same time without the help of the program.
- Step 4: The measure was given a credit if the company was responding to the drought alert (5% for some influence; 10% for big influence). The customer's attention to the utility's need to save water in 2001 was acknowledged here.
- Step 5: Measures were given credit if the participants reported that their organizations planned or took water saving actions outside the program (measure spillover = 5% if planned; 10% if taken).
- Step 6: Measures were given credit if the participants reported changes in attitudes and behaviors likely to maintain or increase water savings (attitude/behavior spillover = 5% if some change; 10% if significant change).

3.6 Evaluation of Program Impacts

The impact analysis results prepared for the sample of measures were used to estimate the gross and net savings for the 2001 program. This was accomplished by estimating realization rates for each technology category, e.g., urinals or single-pass cooling. For each technology category two realization rates were estimated; one for gross savings and the other for net savings. They are defined as follows:

- **Gross Savings Realization Rate**. For each measure the gross savings realization rate is the evaluation team's estimate of savings divided by the program staff estimate of savings. For example, if the evaluation result for gross savings is 1,000 CCF/yr and the program staff estimated 1,200 CCF/yr, the gross savings realization rate is 1,000/1,200 or .83.
- **Net Savings Realization Rate**. To estimate this rate for each project, we first calculate the evaluation team's estimate of net savings. To do this, we multiply the measure's gross savings by the Net-to-Gross Ratio (NTGR). Continuing the example above, if the NTGR for the project is .8, which means that 80% of the gross savings are attributable to the SPU program, the net

savings are .8 * 1,000 CCF/yr or 800 CCF/yr. The net savings realization rate is the evaluation team's estimate of net savings divided by the program's estimate of savings, 800/1,200 or .667. The impact of free-ridership and spillover is equal to gross savings minus the net savings 1,000 - 800 = 200.

These realization rates were computed and used to estimate program-level net and gross savings as follows:

1. SPU provided program savings estimates for all measures completed during 2001. These savings were summed by water efficiency technology category.
2. Gross and net realization rates were estimated for each technology category. This was accomplished by summing the evaluation team's estimate of gross and net savings across all sampled measures for each technology category. The program's savings estimate was also summed for these measures. The gross realization rate for each category was the sum of evaluation team gross savings estimates divided by the sum of the program's savings estimate. The net realization rate for each category was the sum of evaluation team's net savings estimates divided by the sum of the program's savings estimate.
3. The sum of program tracking savings, for each technology category, was multiplied by the gross and net savings realization rates to estimate the gross and net savings for each technology category. The results were summed across all technology categories to estimate overall program savings. The impact of free-ridership and spillover was equal to gross savings minus the net savings.

4 Process Evaluation Methodology

The process evaluation for the program gathered and analyzed information to answer a single overriding question:

> *How well is the program operating from the viewpoint of participants, non-participants, and program staff and supervisors, and how can it better meet its goals and objectives?*

The process evaluation used these data sources:

1. In-depth telephone interviews with decision-makers from the 20 organizations (installing 25 measures), that participated in the 2001 impact evaluation.

2. A panel study of decision-makers from the population of business and institutional (commercial and industrial) customers. This involved two rounds of telephone interviews (in early 2001 and early 2002). The baseline round consisted of a random sample survey of 143 customers. The follow-up survey re-contacted the same organizations a year later and resulted in 78 interviews (the goal was 70). By the second round of interviews, nine of these customers indicated they had "participated" in the program during 2001. According to program records, five of these customers had completed projects during 2001.

3. An interview with three program staff.

4. A review of program materials.

The following sections describe the process evaluation objectives, procedures, and analysis for the three pieces of primary research described above.

4.1 Participant Decision-Maker Survey

4.1.1 Research Questions

For the 20 customers participating in the impact evaluation, the following indicators were used to assess program success: customer satisfaction, marketing effectiveness, vendor involvement in program promotion (the program is designed to be "vendor driven"); and program influence on attitudes and behaviors. The interviews with participants gathered data to address these indicators and other data that would help to understand the context in which the program is operating. In addition, these interviews were the mechanism for gathering free-ridership data. The research questions addressed in the participant interviews were:

- What are the characteristics (and profile) of these organizations (includes factors such as business type, size, water uses, and water efficiency actions and attitudes)?
- How and why did they decide to participate in the program (includes free ridership questions as described in Section 4.1.3)?
- How satisfied were they in terms of program service and delivery; program outreach; and program outcomes?
- What barriers to participating or taking action did they experience?
- Has program participation changed organizational views or actions about saving water (includes free-ridership "credit" questions)?

- What are the strong points and benefits of the program? How can the program be improved?

4.1.2 Methods

Interviews with decision-makers were conducted throughout the program year after projects had been completed and organizations had had some experience with the water efficiency measures. Program staff and/or the impact evaluation contractor provided contact information. The individuals interviewed played key roles in deciding whether or not to install the water saving improvement(s) studied in the impact analysis.

The interview instrument was designed in conjunction with SPU evaluation and program staff, as well as members of the evaluation team. It contained items designed to address the research questions listed above and included both close-ended rating questions and open-ended questions. Interviews took between 30 to 45 minutes. A copy of the interview instrument may be found in Volume 2.

Close-ended interview data was input, using quality control procedures, into a statistical analysis package; open-ended questions were qualitatively analyzed. The codebook for the close-ended questions can be found in Volume 2. Frequency tables for close-ended questions can also be found in Volume 2. Appropriate cross-tabulations have been performed and are discussed in the process evaluation results (Section 6). The database has been provided to SPU evaluation staff.

4.2 Population Baseline and Follow-Up Decision-Maker Surveys

4.2.1 Research Questions

In the population surveys, changes in customer awareness of and interest in the program, conservation attitudes, and conservation actions were assessed. These data were then used to track market changes that affect the program. The panel study of the population of commercial customers gathered information about the following research questions. Where possible, questions for the general population of commercial customers paralleled those for impact analysis participants.

- What are the organizational characteristics of commercial customers (includes factors such as business type, size, water uses, and water efficiency actions and attitudes)?
- How are water efficiency decisions made in their organizations? What would motivate them to participate in the program?
- How aware are commercial customers about the program?
- How interested are they in participating in the program?
- Have they participated in the past?
- What factors, if any, can help predict program participation?
- What are the barriers to participating?

4.2.2 Methods

A total of 143 customers participated in the baseline survey in early 2001 and 78 of these same customers participated in the follow-up survey in early 2002. Decision-makers for the panel study were defined as "the person (or people) in charge of making decisions about how water is used at the building or facility at a particular address."

The panel design was chosen to take advantage of an existing database of commercial customers that had been prepared for survey use in 1996; preparing another database would have been both time consuming and expensive. In addition, the study allowed a representative group of commercial customers to be tracked over time. However, it should be kept in mind that the follow-up survey introduced the potential for bias in certain areas, because the sample may have been made more aware of and interested in the program or in conservation actions due to the survey contact.

For the baseline survey, the survey team used two major approaches to complete the interviews: (1) they called back respondents that participated in the 1996 survey, and, when that did not yield enough results (2) they called through the entire sample list of unique organizations to obtain responses for 143 organizations. Thus, each organization had a roughly equal chance of participating in this survey. Despite reusing the same sampling frame, interviewers met a number of the same, and some different challenges faced in the 1996 survey. These included:

- Finding available respondents (commercial customers are busy and hard to reach)
- Finding the "right" respondent (many contact names had changed and often more than one person had parts of the required information)
- Sorting out new business names, new phone numbers, and cross-referencing accounts at different places on the list

Many situations arose which needed special attention. For example, some organizations had local staff who could discuss water use, but corporate decision-makers were at another location or out of state. In a few cases, companies were not willing to release information about water use in their processes. A typical challenge among small businesses was their complete lack of knowledge or concern about how their water was used. The largest customers had very complex water use and metering situations, which needed to be adapted to the survey format. Still, refusal rates were low once the appropriate respondent was reached.

In the follow-up survey, the challenge was to gain customer agreement the second time around; however, aside from sheer availability, many of the other difficulties in reaching customers had been solved. Customers proved to be very responsive and cooperative; refusal rates were extremely low.

The interview instruments (see Volume 2) were designed in conjunction with SPU evaluation and program staff. The follow-up instrument was changed to reflect new program priorities. Both instruments combine close-ended rating questions with open-ended questions. The telephone interviews took 15-30 minutes.

Data entry for the baseline survey was fairly straightforward; data were coded and input into a statistical package data base using extensive quality control procedures and further data cleaning was performed. Baseline data results were provided to SPU in an interim report. Adding the follow-up survey data to the same data base, however, was more complex, due to the addition of six open-ended questions and other changes to the questionnaire, and the need to cross-check baseline and follow-up data for consistency and accuracy.

All baseline and follow-up interview data now reside in one consolidated database, which has been provided to SPU. Each of the 221 interviews is a unique record and is identified as either part of the baseline or follow-up survey. Volume 2 contains the variables and codes used for both surveys. Where questions were asked only for the baseline or only for the follow-up survey, this is indicated in the codebook.

Frequency results, both weighted and unweighted, from the baseline and follow-up population surveys can be found in Volume 2. Weighted results can be used to examine characteristics of the entire population of commercial customers served by SPU. These results account for the fact that the sample was a stratified random selection of commercial customers. The probability and thus the weight assigned to sampled customers varied greatly depending on the number of customers that were in each stratum. The unweighted results were only used to examine characteristics of the sample for which interviews were completed. Appropriate cross-tabulations and comparisons across the groups can be found in Section 6.

4.3 Interviews with Program Staff

Three program staff participated in a two-hour in-person interview. The questions were very open-ended, asking staff to identify success indicators for the program; to define program steps for participants; to discuss strengths and weaknesses of the program; and to identify program lessons, as listed below:

- How long has WST been operating?
- How many customers has it served so far?
- How has it changed over time?
- What documentation might be useful to help understand the program?
- What's the current climate within SPU for operating this program?
- Please describe how the program is marketed? (e.g., methods, target groups etc) Specifically – how to projects get generated?
- What are the usual steps customers take to participate in the program?
- What are the indicators you used in 2001 to gauge the success of WST?
- For 2001, how well did the program performance meet these indicators?
- What barriers or problems surfaced during 2001?
- How have the site-specific evaluations affected program operation (if at all)?
- What are the strengths of the WST?
- What would you like to see changed or improved about WST? How would you make the improvements? Where is the program going from here?
- What resources do you need to improve the program?
- What are the key lessons to remember from this year's program experience?

5 Impact Evaluation Results

5.1 Gross Impacts

5.1.1 Measure-level Gross Impacts

Table 7 shows program staff and evaluation gross savings estimates for the 25 sampled measures, as well as their corresponding realization rates. Overall, seven of the 25 measures (28%) had realization rates greater than 100%, meaning than the evaluation savings estimate exceeded the program staff estimate. Results for each of the nine evaluated technology categories are discussed in more detail below.

- **Washing machine coin-op:** Only one measure, with small water savings, was evaluated in this technology category. The measure involved horizontal axis washing machines installed in apartment complex laundry rooms. This measure had evaluated savings that were 182% of the program staff estimate of 174 CCF/year.
- **Refrigeration / ice machines:** Eight measures were evaluated in this technology category, representing a variety of applications. In all cases water-cooled refrigeration units was replaced with air-cooled units. Program staff savings for these eight measures varied widely, ranging from 145 to 6,324 CCF/year. Only the largest measure had a realization rate greater than 100%. With this exception, realization rates were low, ranging for the remaining measures from 27% to 80%.
- **Single-pass:** The five measures evaluated in this technology category encompassed three discrete end uses; dental vacuum pumps (McKenny Dental Offices and Dr. Barrett), space cooling (UW-Tubby Graves and UW-Student Union), and air compressor waste heat removal (Standard Steel). The dental vacuum pump measures both had program staff savings estimates of 361 CCF/year, and low realization rates of 29% and 54%. The space cooling measures were the largest of this group, with savings of 1,992 and 4,216 CCF/year, and corresponding realization rates of 99% and 32%. The air compressor measure had program staff savings of 770 CCF/year and an 86% realization rate.
- **Process water:** Both process water measures consisted of hotel ozone laundry systems. Program staff savings ranged from 1,295 to 2,510 CCF/year, with corresponding realization rates of 6% and 80%. The 6% realization rate occurred because of improperly adjusted ozone system settings, and poor operating practices by hotel staff.
- **Other technology:** The two measures in this category reduced shipyard freshwater use and eliminated domestic water pump bleedoff. The first measure had the largest program staff savings estimate among evaluated measures at 25,000 CCF/year, as well as a high realization rate of 170%. The second had much smaller savings, but a very high realization rate of 295%.
- **Tank-type toilets:** These measures involved installing low-flow, tank-type toilets in apartments and hotel guest rooms. They had fairly small program staff savings estimates of about 300 CCF/year each, but high realization rates of 148% to 228%.
- **Flush valve toilets and Urinals:** These measures involved installing low-flow flush valve toilets and urinals in a school and office building. Program staff savings estimates for the three measures in these two technology categories ranged from 664 to 5,604 CCF/year. The measures had realization rates ranged from 34% to 113%.
- **Irrigation:** The two measures in this technology category improved irrigation system controls. Program staff savings estimates for these two measures were 309 and 2,933 CCF/year, and realization rates were fairly high—87% to 100%.

Table 7: Gross Impact Results for Sampled Measures

End Use / Technology	ID#	Facility Name	Program staff savings (CCF/year)	Evaluation savings (CCF/year)	Gross Realization rate (%)
PROCESS					
Washing machine coin-op	WM002	KC Housing Authority	174	317	182%
Refrigeration/ Ice Machines	RIM002	U of W Student Union Building	6,324	8,164	129%
	RIM017	Pike Place Fish	3,187	1,976	62%
	RIM018	Wild Salmon Seafood Market	647	177	27%
	RIM020	Lake Washington School District	500	180	36%
	RIM021	Meydenbauer Center	1,333	627	47%
	RIM022	Meydenbauer Center	145	37	26%
	RIM023	Town Center Mini-Mart Texaco	790	224	28%
	RIM025	Lake Washington School District	470	374	80%
Single-Pass	SPC001	McKenny Dental Offices	361	106	29%
	SPC004	UW - Tubby Graves Building	1,992	1,976	99%
	SPC005	Standard Steel	770	665	86%
	SPC006	U of W Student Union Building	4,216	1,350	32%
	SPC011	Dr Barrett	361	194	54%
Process Water	PW003	Hilton Seattle	1,295	83	6%
	PW005	Renaissance Madison	2,510	2,084	83%
Other Technology	OT002	Todd Pacific Shipyards	25,000	42,603	170%
	OT004	1001 Fourth Avenue Plaza	1,757	5,185	295%
DOMESTIC					
Tank Type Toilets	TTT002	Best Western Executive Inn	340	504	148%
	TTT008	Nyconco Development Corp.	300	685	228%
Flush Valve Toilets	FVT005	Norton Building	2,225	1,690	76%
Urinals	UR004	Lake Washington School District	5,604	2,510	45%
	UR006	Norton Building	664	749	113%
OUTDOOR					
Irrigation measures	IRR003	The Seattle Times, Bothell	2,933	2,554	87%
	IRR008	Hawthorne Square	309	309	100%

5.1.2 Comparison of Tracking and Evaluation Savings Estimates

Table 8 summarizes the major reasons for differences between program staff and evaluation savings estimates for the 25 sampled measures. Reasons that increased evaluation savings are denoted with a (+), while those that decreased evaluation savings are marked with a (-). Reasons that did not apply to the measure are designated with "na" (not applicable). Each measure was examined to see whether these differences fell in the following categories:

- **Flowrate:** A positive sign (+) means that the per unit of water usage, e.g., per flush, per day, per hour, was higher in the evaluation pre-installation scenario (compared to the corresponding program staff scenario), lower in the evaluation post-installation scenario, or both. A negative sign (-) means that the opposite conditions occurred.
- **Hours of Operation:** A positive sign (+) means that the measure-affected equipment or system operated more in the evaluation pre-installation scenario, less in the evaluation post-installation scenario, or both. In cases where the measure did not affect equipment hours of operation, then a (+) indicates more hours than originally assumed. A negative sign (-) means that the opposite conditions occurred.
- **Usage/Production Levels:** A positive sign (+) means that the measure-affected equipment or system received more use than the program staff analysis originally assumed. Examples include washing machines running more loads, ice machines producing more ice, and toilets being flushed more times, all on a per unit time basis. A negative sign (-) means that the opposite conditions occurred.

Results for each of the nine evaluated technology categories are discussed in more detail below.

- **Washing machine coin-op:** The lone measure had a realization rate greater than 100% because the washers received much more use (loads per day) than the program staff originally assumed.
- **Refrigeration / ice machines:** Measured flowrates were less—sometimes significantly so—than the program staff assumptions for nearly all of the eight measures. Overly optimistic flow assumptions based on manufacturer's data were the cause in several instances. Potentially wide variation in cooling water flowrates, as well as compressor loading associated with refrigeration requirements, made it difficult to predict savings accurately for this technology category.
- **Single-pass:** These five measures encompassed three discrete end uses; dental vacuum pumps, space cooling, and air compressor waste heat removal. All of them had evaluation flowrates lower than originally assumed. For both dental vacuum pump measures, the flowrates in particular were significantly lower than program staff assumed, resulting in the low realization rates. The manufacturer-supplied pump flow estimates appeared overly optimistic for these cases. Variations in assumed operating hours had a minimal effect on the difference between the two estimates.

  For the remaining three measures, only one of them (UW-Student Union) had a significantly lower flowrate. This occurred because of inaccurate engineering estimates of flow and compressor load factor in the program staff analysis.
- **Process water:** The two hotel ozone laundry measures both had lower evaluated water savings per load. In one case, the unit water savings were dramatically lower because the new system was improperly set up, offsetting increased savings from higher laundry loads.
- **Other technology:** The both measures in this group savings were inherently difficult to estimate. In both cases, short-term metering produced enhanced estimates of average flowrates, which were

much higher than the program staff estimates. The program staff estimates were intentionally conservative.

- **Tank-type toilets:** Both tank-type toilet measures showed higher savings per flush than originally estimated. In addition, measured flushes per day were higher than assumed by program staff.
- **Flush valve toilets and Urinals:** For all three of these measures, evaluated savings per flush were higher, and flushes per day were lower, than program staff assumed.
- **Irrigation:** Comparing evaluation and program staff results was difficult for these two measures, since they used very different analysis approaches. In one case, the evaluation and program staff estimates matched exactly, while the other was slightly lower, mainly because of evaluation adjustments to baseline usage assumptions.

5.1.3 Measure Performance Findings

While conducting our gross impact evaluation, a great deal of data was collected about the performance of various types of water-savings technologies. This information, which includes, for example, statistics about average flush counts and laundry room usage, can provide a basis for estimating savings for future program applications. It should be noted, however, that while the numbers below are a reasonably accurate depiction of what was encountered over the range of measures that were evaluated, they are not meant to be representative of the whole range of performance that one might encounter on any potential project. With that in mind, these findings should be used conditionally, depending on the analyst's judgment.

Significant findings that may be generalized to other projects are listed below by technology type.

5.1.3.1 Toilets and urinals

- Flush volumes (in gallons) for older fixtures are: 4.8 (flush valve toilets), 3.5-4.3 (tank-style toilets), 1.9-4.8 (urinals).
- Flush volumes (in gallons) for efficient fixtures are: 1.9 (flush valve toilets), 1.5 (tank-style toilets), 0.8-1.1 (urinals).
- For an office with manually-flushed toilets, the men's and women's toilets average 4.8 and 18.9 flushes per toilet per weekday, respectively.
- For offices and schools, about 15 flushes per urinal per weekday is typical.

5.1.3.2 Irrigation

- Typical baseline irrigation levels for mixed landscape/lawn areas are 14-18 cubic feet of water per year per square foot of landscaping.

5.1.3.3 Laundry ozone systems

- Hotel laundry production ranges from 11.1-17.8 lbs. of laundry per occupied room per day. Properly commissioned ozone systems can save 0.26-0.97 gallons per lb. of laundry.

5.1.3.4 Single-pass cooling

- Refrigeration: Condensing water flowrates range from 0.58-0.73 gpm per rated ton of cooling. Compressor duty cycles range from 19-48%.

- Ice machines: Condensing water flowrates range from 0.24-1.0 gpm per 1000 lbs. of rated ice production capacity. Compressor duty cycles range from 10-100%.

- Air conditioning: Condensing water flowrates range from 0.13-3.8 gpm per rated ton of cooling.

5.1.3.5 Dental vacuum pumps

- Dental vacuum pumps use 0.05-0.25 gpm per motor horsepower.

5.1.3.6 Coin-op washing machines

- Traditional and efficient horizontal-axis washers use 32 and 20 gallons per load, respectively, for savings of 12 gallons a load. Laundry room washers in large multifamily housing complexes average about 2.4-3.7 loads per washer per day.

5.1.4 Evaluation Estimate of Gross Savings for the 2001 Program

Table 9 shows the evaluation estimate of gross savings for each water efficiency technology category and for the program as a whole. The estimates of gross realization rate and evaluation gross savings were prepared using the method described in Section 3.6. The gross realization rate for most (six of nine) technology categories is less than one, indicating that the evaluation estimates of savings are less than the program staff estimates. The lowest realization rate was for urinals (52%). The gross realization rate for three technology categories is greater than one, indicating greater evaluation savings estimates. The highest realization rate was for tank type toilets (186%). The result for process technology is mostly determined by one very large measure installed at the Todd Shipyards. This measure had a substantial impact on the overall realization rate for the program. The total gross savings for the program were estimated to be 162,588 kWh, which is 109% of the program savings based on program staff estimates.

5.2 Net Impacts

5.2.1 Measure-level Net Impacts

Interviews with the participant sample included questions that were used to assess free-ridership and spillover. A program participant becomes a free rider when they receive an incentive to install a water efficiency improvement, even though they would have installed the same improvement in the same time frame without the help of the program. Program assistance may help the customer decide to act, or help the customer to install equipment more quickly. Spillover occurs when the customer is influenced by the program to implement additional water savings measures beyond those for which an incentive is paid.

A six-step protocol, based upon answers decisions-makers gave in the participant surveys, was used to assess the level of free-ridership and spillover for each measure. The results of this scoring and the final Net-To-Gross Ratio (NTGR) for each measure is shown in Table 10.

The heart of the free-ridership and spillover scoring rests with the self-rating supplied by the respondent (see "Self-Report Score" definition below). We felt the participants' overall sense of whether they would

Table 8: Reasons for Differences between Program and Evaluation Savings Estimates

End Use / Technology	ID#	Facility Name	Realization rate	Reasons for differences*		
				Flowrate	Hours of operation	Usage/ Production levels
PROCESS						
Washing machine coin-op	WM002	KC Housing Authority	182%	na	na	(+)
Refrigeration/ Ice Machines	RIM002	U of W Student Union Building	129%	(+)	na	na
	RIM017	Pike Place Fish	62%	(-)	na	na
	RIM018	Wild Salmon Seafood Market	27%	(-)	(-)	na
	RIM020	Lake Washington School District**	36%	-	-	-
	RIM021	Meydenbauer Center	47%	(-)	na	(-)
	RIM022	Meydenbauer Center	26%	(-)	na	(-)
	RIM023	Town Center Mini-Mart Texaco	28%	(-)	na	na
	RIM025	Lake Washington School District**	80%	-	-	-
Single-Pass	SPC001	McKenny Dental Offices	29%	(-)	(-)	na
	SPC004	UW - Tubby Graves Building	99%	(-)	na	na
	SPC005	Standard Steel	86%	(-)	na	na
	SPC006	U of W Student Union Building	32%	(-)	na	na
	SPC011	Dr Barrett	54%	(-)	(-)	na
Process Water	PW003	Hilton Seattle	6%	(-)	na	(+)
	PW005	Renaissance Madison	83%	(-)	na	(-)
Other Technology	OT002	Todd Pacific Shipyards	170%	(+)	na	na
	OT004	1001 Fourth Avenue Plaza	295%	(+)	na	na
DOMESTIC						
Tank Type Toilets	TTT002	Best Western Executive Inn	148%	(+)	na	(+)
	TTT008	Nyconco Development Corp.	228%	(+)	na	(+)
Flush Valve Toilets	FVT005	Norton Building	76%	(+)	na	(-)
Urinals	UR004	Lake Washington School District	45%	(+)	na	(-)
	UR006	Norton Building	113%	(+)	na	(-)
OUTDOOR						
Irrigation measures	IRR003	The Seattle Times, Bothell	87%	na	(-)	na
	IRR008	Hawthorne Square	100%	na	na	na
~~**Percentages for all sampled projects**~~						
Evaluation value yields MORE savings than program (+)				**40%**	**0%**	**33%**
Evaluation value yields LESS savings than program (-)				**60%**	**100%**	**67%**

* (+) evaluation > program value. (-) evaluation < program value. na = not applicable.

** Detailed program calculations unavailable, so no comparison possible.

Table 9: Evaluation Estimate of Program Gross Savings

End Use / Water-Efficiency Technology	Program Staff Savings (CCF/yr)	Gross Realization Rate (%)	Evaluation Gross Savings (CCF/yr)
Process			
Washing Machine Coin-Op	2,705	182%	4,929
Refrigeration / Ice Machines	17,474	88%	15,339
Single-Pass	12,401	56%	6,910
Process Water	12,954	57%	7,378
Other Technology	39,405	179%	70,378
Tank Type Toilets	4,475	186%	8,318
Flush Valve Toilets	2,925	76%	2,222
Urinals	7,164	52%	3,725
Irrigation	49,132	88%	43,390
All End Uses and Technologies	**148,636**	**109%**	**162,588**

have installed the same measure, at the same time, in the absence of the program was the most legitimate starting place. At this point, respondents had no reason to overstate the importance of the program as they had already been paid. However, it is possible that looking back they might see themselves as more independent of the program than they really were. Still, in most cases, the decision process seemed quite clear and when the "stories" and the ratings are compared across the projects, the ratings appear quite consistent relative to one another.

In one case, an issue arose that is important to consider for future evaluations. One respondent told us he had a broken piece of equipment that had to be replaced. He contacted his vendor who recommended a water saving model. The respondent subsequently told the vendor he wanted to buy the equipment. Then, he said the vendor mentioned the program. He clearly felt he would have installed the same equipment without the program, but he was glad to have the incentive. We accepted his view and self-rating for free-ridership.

This situation, however, raises the issue of how to consider the role and value of vendors in "selling" this program. Our current understanding is that the program intends to be "vendor driven." However, this evaluation was not designed to assess vendor roles and impacts, including how to handle their influence on free-ridership and spillover scores.

In reviewing the table below, few reliable trends or patterns emerge in terms of trends within measures or by type of customers; scores appear to be fairly individualized. The lower total scores often have to do with equipment breaking or the organization already having budgeted for the equipment. The middle scores reflect organizations that were more uncertain about what course of action to take. The organizations that simply could not afford to act without the program received the higher scores.

The definition of each column in Table 10 is as follows (see Volume 2 of this report for a full description of the protocol used to assess the Net-to-Gross Ratio):

- **Self-Report Score**. Answer to the question: "On a scale of 1 to 10, with 1 being very unlikely

Table 10: Measure-specific Net-to-Gross Ratio

End Use / Water-Efficiency Technology / Facility Name	Self-Report Score	First-Time Participant	Actions Before Application	Response To Drought	Other Water Saving Actions	Water Saving Attitudes	Total Score	Net-To-Gross Ratio (%)
Process								
Washing Machine Coin-Op								
KC Housing Authority	50	5		5	5	5	70	70%
Refrigeration / Ice Machines								
U of W Student Union Building	40	5		5	5	5	60	60%
Pike Place Fish	50	5			5	5	65	65%
Wild Salmon Seafood Market	50	5		10	5	5	75	75%
Lake Washington School District	20						20	20%
Meydenbauer Center	80	5		5	5		95	95%
Meydenbauer Center	80	5		5	5		95	95%
Town Center Mini-Mart Texaco	20	5				10	35	35%
Lake Washington School District	20						20	20%
Single-Pass								
McKenny Dental Offices	90	5		10			100	100%
UW - Tubby Graves Building	10	5			5	5	25	25%
Standard Steel	10	5	-25	10	10	10	20	20%
U of W Student Union Building	40	5		5	5	5	60	60%
Dr Barrett	10	5		10			25	25%
Process Water								
Hilton Seattle	30	5			5	5	45	45%
Renaissance Madison	30	5				5	40	40%
Other Technology								
Todd Pacific Shipyards	60	5		10	5	10	90	90%
1001 Fourth Avenue Plaza	60	5		5	5	10	85	85%
Tank Type Toilets								
Best Western Executive Inn	10			5	10	5	30	30%
Nyconco Development Corp.	50	5			5		60	60%
Flush Valve Toilets								
Norton Building	50					10	60	60%
Urinals								
Lake Washington School District	20						20	20%
Norton Building	50					10	60	60%
Irrigation								
The Seattle Times, Bothell	80	5			5	10	100	100%
Hawthorne Square	10	5		5			20	20%

and 10 being very likely, how likely would you have been to install the **exact same measure in the same time frame on your own,** without the help of the program?" The responses were multiplied by a factor of ten to produce the scores reported in Table 10.

- **First-Time Participant**. The measure is given a credit of 5% if the organization is participating for the first time.
- **Actions Before Application.** The measure has credits deducted if equipment was bought in advance (-25%) or installed (-50%) before submitting a program application.

- **Response To Drought**. The measure is given a credit if the company was responding to the drought alert (5% for some influence; 10% for big influence).
- **Other Water Saving Actions** . Measures were given credit if the participants reported that their organizations planned or took water saving actions outside the program (measure spillover = 5% if planned; 10% if taken).
- **Water Saving Attitudes**. Measures were given credit if the participants reported changes in attitudes and behaviors likely to maintain or increase water savings (attitude/behavior spillover = 5% if some change; 10% if significant change).

No score was allowed to fall below 0 or to be above 100.

5.2.2 Evaluation Estimate of Net Savings for the 2001 Program

The final step in the impact evaluation was to estimate the program's net savings. Table 11 shows the net savings results and the overall program realization rate that accounts for both the gross and net realization rates. The estimates of program realization rate and evaluation net savings were prepared using the method described in Section 3.6. When both gross and net realization rates were applied, an estimate of 127,241 CCF/yr for the 2001 program was derived. This is 86% of the program staff's estimate of savings for the program of 148,636 CCF/yr.

Table 11: Evaluation Estimate of Program Net Savings.

End Use / Water-Efficiency Technology	Program Staff Savings (CCF/yr)	Gross Realization Rate (%)	Evaluation Gross Savings (CCF/yr)	Net-to-Gross Ratio (%)	Evaluation Net Savings (CCF/yr)	Program Realization Rate (%)
Process						
Washing Machine Coin-Op	2,705	182%	4,929	70%	3,450	128%
Refrigeration / Ice Machines	17,474	88%	15,339	61%	9,308	53%
Single-Pass	12,401	56%	6,910	37%	2,563	21%
Process Water	12,954	57%	7,378	40%	2,965	23%
Other Technology	39,405	179%	70,378	89%	62,958	160%
Tank Type Toilets	4,475	186%	8,318	47%	3,933	88%
Flush Valve Toilets	2,925	76%	2,222	60%	1,333	46%
Urinals	7,164	52%	3,725	29%	1,087	15%
Irrigation	49,132	88%	43,390	91%	39,644	81%
All End Uses and Technologies	**148,636**	**109%**	**162,588**	**78%**	**127,241**	**86%**

6 Process Evaluation Results

6.1 Participant Decision-Maker Survey

The results of the 20 interviews with program participants that were part of the impact analysis are presented in this section. These interviews included questions about the organizations' experiences with the program and about the measures installed. For impact evaluation purposes, where organizations had taken multiple measures, results were tabulated for each measure (N=25). When we interviewed organizations that had installed multiple measures, the organizations, after being specifically asked about this issue, did not regard the measures as separate experiences with the program. Still, some of the questions need to reflect a measures perspective.

In the following discussion, where questions were specifically related to the measures, percentages use the 25 measures as the base. These questions are gathered in one section and identified as "measure level." Otherwise, the findings are discussed from an organizational (N=20) perspective. To remind the reader of the small number of respondents, percentages are often followed with the actual number(s). In addition to analyzing the interview results, we reviewed 132 water efficiency measures (all 123 measures that received incentives from the program in 2001 and 9 measures from 2002 that were sampled for the impact evaluation) to gather insights about the effectiveness of the program's target marketing efforts..

The following topics are covered in this narrative:

- Organizational characteristics
- Program awareness, knowledge, interest, past participation, and target marketing
- Reasons to participate, the decision-making process, and satisfaction with measures (measure level)
- Satisfaction with the program

More detailed information from open-ended responses can be gained by looking at the evaluation database that accompanies this report. This database contains verbatim comments for each open-ended question. Reviewing these comments may help program staff better understand the very specific circumstances and concerns of these participants.

6.1.1 Organizational Characteristics

The 20 organizations participating in the impact study had the following characteristics:

- High level or dedicated water use decision-makers that fell into three almost equal categories: upper management owner/partners, 40%; chief engineers, 30%; and facilities managers, 30%.
- Building owners: 75% of the organizations owned the building or facility, while 20% leased, and 5% managed it.
- Split of single and multiple-building occupancy: half of organizations owned, occupied, or managed other buildings in the area.
- A large variety of business types, including 45% that fell into the 'other' category that included dental offices, multi-family housing, newspaper printing, a shipyard, and a convention center. Fifteen percent each were either hotels or educational facilities, 10% were offices, and 5% each were manufacturers, groceries, and mixed use buildings.

- Smaller or larger building sizes. 35% were under 10,000 square feet, and 45% over 100,000 square feet, while 20% were in the 10,000 - 100,000 square foot range.

6.1.2 Program Awareness, Knowledge, Interest, and Past Participation

Insights about participant awareness, knowledge, interest, past participation, and barriers to participation can help identify how best to meet customer needs and increase customer response to the program.

- 25% (5 of 20) of respondents could recall the Water Smart Technology name unaided.
- 80% (16) of respondents said this was the only time their organizations had participated in Water Smart Technology. Three had completed prior projects and 1 mentioned a concurrent project at the time of the survey.
- 40% of respondents said they felt 'very informed' about the program, while the remainder felt "somewhat informed'.
- When asked how they became aware of the program, 35% (7 participants) said they learned of it through utility ads and marketing information, 30% (6 participants) heard about it through a vendor contact, 10% found out through a business associate, and 25% through other sources.
- Participant views about the level of program awareness among their business colleagues varied, although most thought it was not particularly well known. Thirty percent said the program was known by many, 15% said it was known by some, 40% said it was not well known, and 15% were not sure how well it was known among their business associates.
- A review of 132 measures that received incentives (123 measures for 2001 and the 9 measures from 2002 sampled for the impact evaluation) shows most of the 79 indoor measures (65%) were installed in the targeted segments. Of these indoor measures, 25% were installed in schools; 28% in hotels and restaurants; 6% in medical and dental facilities; and 6% in large or institutional facilities. Most of the 53 irrigation measures (81%) were installed in institutional playgrounds, parks, and community centers. While the target marketing is clearly working, the "depth" of awareness within target segments may still not be very great (for instance, most measures installed in educational facilities were within two organizations).
- Participants gave a variety of responses to the question about major barriers that the organization faces in reducing water use even further. The two most popular responses were that they did not have the money (25%) or that they cannot control the behavior of the visitors, patients, customers, etc.

6.1.3 Reasons To Participate, The Decision-Making Process, And Satisfaction With Measures

Respondents were asked a series of questions to better understand why they participated in the program, how decisions were made, and their satisfaction with the measures installed. These questions all used the base of 25 measures.

- For almost half of the measures (48% of 25), "water savings" or "conservation" were the most important reason they were installed. For about a third of the measures (32%), cost savings were the primary reason, and for the remaining 20% of measures, equipment was failing or inefficient and needed to be replaced. When asked if there were other important factors in deciding to participate, those giving costs savings as the first reason tended to mention water savings or conservation as another important reason.

- For 76% of the measures, organizations had done research and/or planning prior to submitting an application to the program, with some doing extensive planning right up to the point of buying the equipment. For one measure, the equipment had already been purchased.
- For 44% of the measures, organizations report they would have been likely to install their measures without the help of the program. In these cases, it was more likely that equipment was failing and needed to be replaced, that the new equipment cost so much less to operate, that it simply made sense to install it, or that replacement had already been budgeted before applying to the program.
- Another 40% of measures may or may not have been installed without the program. In these cases, organizations were less sure what their course of action would have been without the program. These decisions were clearly influenced by the program rebate but, in addition, organizations often needed to replace equipment because of its age and/or inefficiency.
- For 16% of the measures, the organization would have been very unlikely to install without the program. Respondents said the measure would not have been approved by management that payback would not have been fast enough, or that it simply was too expensive a measure without the rebate.
- With 20% of the measures, the 2001 drought was reported as a 'big influence' in the decision to go ahead, while in 24% of the measures it was somewhat of an influence. For just over half of the measures (56%) said the drought was not an influence in their decision-making.
- For 88% of the measures, the financial incentive was very or somewhat important to organizations in terms of installing the measures at this time. Only 12% mentioned the incentive as "not too important," and in each of these cases the organizations said they would have been very likely to install the measure without the program.
- When asked if the incentive was too low, too high, or about right for the 25 measures, it was deemed "about right" for 80% of the measures. For 20% of the measures, respondents thought the incentive was too low (this was especially a concern for one resource efficient washer measure). The incentive was not rated as too high for any of the measures.
- Despite generally finding the incentive important and at the appropriate level, participants reported that most measures (80%) would still have been installed if the incentive had been 50% less. For those measures, it was still a good deal for half (48%) of the measures or the measure was already budgeted (8%). In another 24% of the measures, the need to save water was cited.
- Satisfaction with the operation of measures taken was very high, with no measures being rated as unsatisfactory. Two-thirds (68%) of the measures received a very satisfied rating and 32% received a somewhat satisfied rating.
- In almost every case (96%), measures were expected to decrease water bills. In one case, the respondent had not seen results yet and so did not know if bills would actually drop.
- For a third of the measures (32%), the organizations did not know how much money they would save annually on the measures taken. This was for a variety of reasons, including that the respondent did not see the bills, the equipment savings were obscured in the overall water use of the organization, the equipment installed was used seasonally and had not been turned on yet (for irrigation), or accurate measurements had not been taken yet. In two cases, respondents could not identify dollar amounts but estimated water savings in gallons per day or year.
- For the two-thirds of measures where estimates were give in annual dollar savings, the total estimated annual amount saved was $401,600. Those estimating dollar amounts tended to say they were offering a conservative number. Savings for individual participants differed substantially, ranging from $800 to $200,000 annually. The median estimated amount saved was

$8,000.

6.1.4 Satisfaction with the Program

Respondents were asked about their satisfaction with nine attributes of the program. In general, satisfaction was high, particularly with participants who had installed multiple measures. Participant ratings on the nine service attributes were:

- For overall program operation and services, 80% (16 of 20) were very satisfied and 20% were somewhat satisfied.
- 75% (15 of 20) were very satisfied and 20% somewhat satisfied with communication of program benefits.
- 30% were very satisfied and 50% were somewhat satisfied with program outreach and marketing. Many respondents recommended that SPU should do more to advertise and market the program. This was the lowest rating of program satisfaction by far.
- 75% were very satisfied and 20% somewhat satisfied with program rules and requirements.
- 75% were very satisfied and 15% somewhat satisfied with the application and paperwork process.
- 70% were very satisfied and 25% somewhat satisfied with the technical proficiency of the staff. One multiple-measure respondent commented that he 'could have gotten a PhD in water conservation' from the SPU technical staff. Several others also made positive comments about the technical staff.
- 65% were very satisfied and 35% somewhat satisfied with the communication, follow-through and support of the staff.
- 75% were very satisfied and 10% were somewhat satisfied with the project approval process.
- 60% were very satisfied and 10% somewhat satisfied with the payment procedures. 25% did not know what to rate this attribute, generally because they had not been paid yet. Those who had been paid tended to very happy with the speed and efficiency of this aspect of the program.

Other indicators of participant satisfaction with the program, and program benefits, include:

- 80% of respondents reported they did not experience any barriers to participating in the program.
- 40% cited the rebate or cost savings as the greatest strength of the program, while 30% mentioned saving water, 20% said SPU's expertise, and 10% said it was simply getting the new equipment.
- In terms of the most important things to improve, the largest group, 40%, mentioned marketing and advertising, supporting a previous finding listed above. There was a sense that SPU needed to be more pro-active in getting the word out. A quarter (25%) said nothing needed improvement or that they were satisfied with the program as is. A small proportion (15%) wanted faster payment procedures or more rebate dollars. And another 15% suggested savings measurement improvements.
- The program message spilled over into other parts of the organization, with 70% of respondents saying their participation had prompted organizational changes. Actual effects were wide-ranging. Some cited increased management interest in saving water when they realized how costly the old equipment was. Others focused on changing employee awareness. One chief engineer said that an engineer in his firm, managing the building across the street, heard about the program through him and signed up as a consequence. One respondent said they went out and

bought $10,000 worth of meters on their own to closely measure water use throughout their company.

- 60% of respondents said participating had prompted them to plan additional water saving actions on their own outside the program, while 15% said they had already taken some action. Those who were not planning or taking actions generally said they had already done everything they could do to save water.
- 85% of respondents said it was very important for their organization to save water. The remaining 15% said it was somewhat important.
- 70% of respondents overall thought they could save at least 1% of the water they are using today, 40% thought they could save between 1% and 5% more, 10% cited the 5%-10% range, and 20% of respondents thought they could save 10% or more.
- 95% of respondents overall said that the actions of commercial/ institutional/ industrial customers could greatly or somewhat affect whether we have enough water to meet future demands, and 60% of respondents said organizations like theirs could greatly affect whether we have enough water in the future
- Respondents offered up several ideas when asked what final advice they had for the utility on how best to work with them on water efficiency.

    - The most-offered suggestion was to increase marketing and advertising efforts for the program. Several suggested sending out flyers or publicizing any new information about innovative water-saving technologies or programs. Both dental respondents said the program was little known among their colleagues and felt the program could be better publicized to this group.
    - One respondent thought the website should have information both on rebate programs and on how effective such programs have been in the past.
    - Another suggested supplying water meters at a reduced costs so that larger organizations could accurately measure water use in specific areas such as car washing.
    - Two respondents suggested offering more flexibility on assistance, either by offering up-front money or by offering in-kind services such as contracting assistance

6.2 Population Baseline and Follow-Up Surveys

The panel study, conducted with representative samples of the population of commercial decision-makers (people within an organization "in charge of making water use decisions"), included 143 organizations in the baseline survey (January 2001) and 78 organizations in the follow-up survey (January 2002). This research design provides two snapshots of the commercial customer population in terms of:

- organizational characteristics
- water uses and water saving actions
- attitudes about water conservation
- awareness, participation in, and interest in WST

Further information on the sample selection and methods used to conduct this research can be found in Sections 2 and 4 of this report. Survey instruments and weighted and unweighted frequencies for each survey may be found in Volume 2 of this report. Unless otherwise indicated, the results presented in this

section have been weighted to reflect population proportions and do not include missing data. Some changes occurred in the survey instrument from the baseline to the follow-up, with some questions being taken out and others added; an "NA" in a table indicates the question was not asked. Finally, given the error margins for the actual sample sizes, differences of less than 10% were generally not regarded as significant.

6.2.1 Organizational Characteristics

Table 12 compares the organizational characteristics of the two samples. The two samples are very similar despite the difference in unweighted sample size (143 to 78). Thus, in both samples about 70% of organizations surveyed were in the Seattle direct service area, while about 30% were in purveyor areas), and by weighting the distribution by small, medium, and large consumers are the same.

The largest share of decision-makers was in upper management, but middle managers and facilities managers also make water decisions. Office managers rarely make these decisions, however. In 78% of the cases, the same respondent was interviewed, but in 22% of the cases, a new person was in charge of water related decisions, indicating a sizable turnover of contacts.

About a third of organizations have more than one building at the site that the decision-maker managed, and about two-thirds own their buildings. There are many types of organizations in the buildings in the service area, spread out over many categories. The largest proportions are in non-food retail, manufacturing (from small to large), education, and other combinations, indicating the diversity of the commercial sector. While the largest share of commercial customers is housed in smaller facilities under 10,000 square feet, about a third have mid-sized space (10,000 – 50,000 square feet).

The final characteristic in the table is a reminder that the percent of overall costs that organizations spend on water and wastewater is usually small: 61% in the baseline and 82% in the follow-up survey report they spend less than 1% on these costs.

6.2.2 Water Uses and Water Saving Actions

Both surveys asked organizations to chronicle their water uses and then to choose their largest uses. As shown in Table 13, their water use is spread across a large number of end uses, with all organizations having restroom uses, most having indoor cleaning, and half reporting they use water for outdoor cleaning. Beyond these three most frequent uses, a third to a fifth of customers consume water for irrigation, industrial processes, food service, refrigeration, laundries, and cooling systems.

Table 14 shows what customers believe to be their top two uses. Restrooms again led the list, with indoor cleaning following, and, more distantly, outdoor cleaning, food service, laundry, and industrial processes. Customers were also asked whether they had taken steps to save water either over the past two years (for the baseline survey) or in 2001 only (for the follow-up survey). Given the drought alert and consumption data that showed a significant drop in water use among commercial customers during 2001, this topic was more thoroughly explored in the follow-up survey. Results indicate that 58% of customers took at least one action to save water during 2001 and that this level of action was significantly greater – and perhaps double – the level of activity in each of the prior two years.

The table below compares baseline and follow-up data for conservation actions that customers took to reduce any of their three largest water uses. While the percent taking no actions to address their largest three uses remained about the same, those taking 1 action increased somewhat and those taking 2 actions increased dramatically. When the number of actions is multiplied by the number in the population, the

Table 12: Characteristics of Commercial Customers

	Baseline	Follow-Up
	%	%
Utility Representation		
Seattle	71	68
Purveyor	29	32
Sample Strata		
Small	70	70
Medium	21	21
Large	9	9
Very Large	<1	<1
Same or Different Respondent (follow-up only)		
No	NA	22
Title of Respondent		
Upper Management	40	47
Facilities Manager	17	22
Middle Manager	33	24
Office Manger	4	6
Other	5	<1
Multiple Buildings at Site		
Yes	39	32
Own/Lease/Manage Building		
Own	65	74
Lease	35	25
Manage	<1	<1
Primary Business Type In Building		
Manufacturing	16	13
Office	8	2
Mixed Use	10	12
Restaurant	4	3
Grocery	<1	<1
Non-food Retail	20	28
Warehouse	14	9
Education/Church	9	12
Hotel/Motel	2	3
Medical/Nursing Home	3	1
Other	14	16
Floor Area (Square Feet)		
Under 10,000	59	48
10,000-50,000	28	34
50,000-100,000	9	13
100,000+	4	5
% of Overall Costs Spent on Water/Wastewater		
<1%	61	82
1-5%	35	15
>5%	4	3
Overall Weighted N Notes: Ns may vary by question due to missing data. Percentages many not total 100% due to rounding.	22405	22405

Table 13: Commercial Water Uses

Water Uses	Baseline	Follow-Up
	%	%
Restrooms, including baths and showers	100	100
Indoor cleaning – floors, walls, bathroom	99	94
Outdoor cleaning	52	61
Outdoor watering, irrigation	30	30
Industrial processes	15	25
Food service – inc. restaurants, caterers	18	20
Refrigeration	21	20
Laundry	17	18
Cooling systems or cooling towers	31	17
Any water loss (you know of) due to leaks	4	7
Flood flushing (flushing out pipes or systems – usually for industrial or manufacturing systems)	3	<1
Other major uses?	23	26
Overall Ns (Ns may vary slightly by use)	22405	22405

Table 14: Summary of Top Two Water Uses

Two Largest Water Uses	Baseline		Follow-Up	
	%		%	
	Top Use	2nd Use	Top Use	2nd Use
Restrooms, including baths and showers	70	20	65	33
Laundry	2	2	7	2
Outdoor cleaning	3	12	7	12
Industrial processes	7	3	6	8
Food service – inc. restaurants, caterers	5	6	3	10
Refrigeration	2	<1	1	1
Indoor cleaning – floors, walls, bathroom	2	44	1	30
Outdoor irrigation	<1	4	5	2
Cooling systems or cooling towers	-	2	-	1
Any water loss (you know of) due to leaks	-	-	-	-
Flood flushing (flushing out pipes or systems – usually for industrial or manufacturing systems)	-	<1	-	-
Other major uses?	9	5	9	1
Overall Ns Percentages many not total 100% due to rounding.	22405	22287	22404	21200

Table 15: % of Customers Taking Water Saving Actions

Number of Actions Taken	Baseline (for two years)	Follow-Up (for 2001 only)
None	42	48
1 Action	37 (18% per year)	25
2 Actions	15 (7.5% per year)	23
3 Actions	6 (3% per year)	3
N =	22405	22405

total actions for 2001 is about equal to the total actions for both 1999 **and** 2000, or double the rate of actions taken (on a per year basis).

Further information on water saving actions taken in 2001 is presented in the remainder of this section. The types of steps customers took to reduce their top three water uses is shown below. The graph provides the percentage among just those customers taking steps and among the whole commercial customer population; steps being taken by less than 5% of the population are not shown. Toilet replacement far outstrips other types of water conserving actions, but customers also took many other types of actions.

Almost all customers taking action to reduce their largest water use in 2001 said that the steps were permanent (89%). Only 4% credited their utilities for helping them with advice (2%) or both advice and an incentives (2%). All follow-up respondents were asked if they planned to take any steps during the next year to save water with their largest use, and 9% reported they planned to take some action.

All respondents to the follow-up survey were also asked if "they had taken any other steps to save water that they had not mentioned." Notably, 15% said they had taken steps to reduce use outside their top three uses. These activities included some interesting actions (note: all percents are for the subset of customers taking action): reducing staff and hours of operation (23%), monitoring use more closely (6%, and saving on water outdoors by not watering plants and other actions (10%). (Note: More specific information about steps taken is available by reviewing the survey forms, since these questions were open-ended and responses were content analyzed and coded.)

All the organizations in the follow-up survey that had **any** water saving actions were asked for their reasons behind taking action. Their reasons are shown in Table 17. Notably, many respondents cited lower maintenance as a reason to act (46%), either on its own (22%), or in combination with saving on water related costs (24%). Interestingly, 17% said they achieved water savings by taking other actions. Conservation and responding to the water shortage showed up in 21% of the responses.

6.2.3 Attitudes About Water Conservation

Survey respondents were asked a number of questions to better understand organizational views of water conservation, as shown in Table 18 below. Attitudes of commercial customers appear to be in flux. Fewer respondents in the follow-up survey said that the actions of commercial customers could have a great impact on whether we have enough water (57% down to 45%), and fewer said saving water is very important to their organizations. (This could reflect worse economic conditions in the region.) On the other hand, when asked what percent they could save, a larger proportion feel they can save more: 68%

Table 16: Incidence of Water Efficiency Actions Taken in 2001

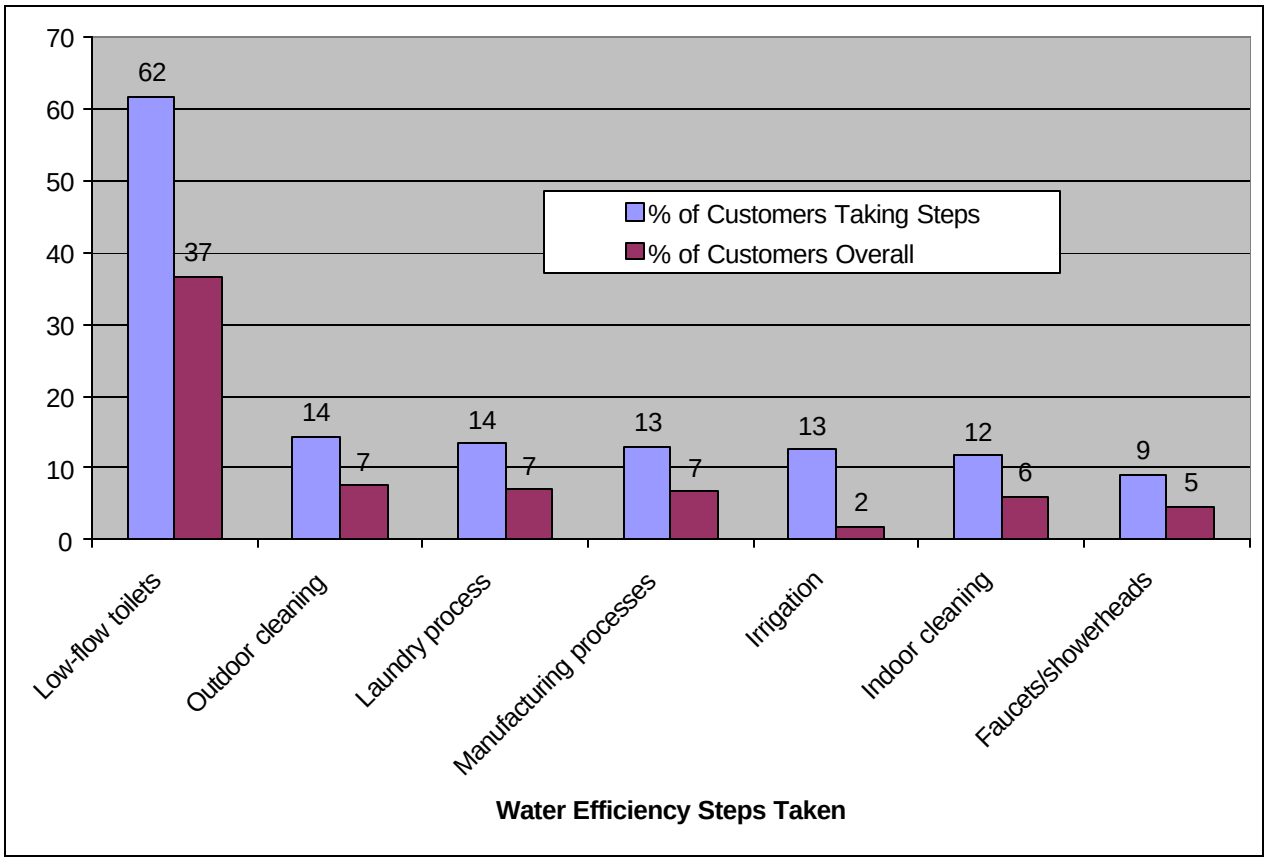


Table 17: Reasons to Save Water in 2001 (follow-up survey only)

Reasons	%
Maintenance and cost savings	24
Maintenance alone	22
Mainly cost savings	17
Water savings a by-product (actions taken for other reasons such as replacement or saving energy)	17
Cost savings and conservation	9
Conservation and water shortage	8
Cost savings and water shortage	3
Maintenance and conservation	1
N of Population Subset	12964

Table 18: Summary of Attitudes About Water Conservation

Attitudinal Questions	Baseline	Follow-Up
	%	%
How much can commercial customer actions affect if we have enough water?		
Great	57	45
Somewhat	36	52

Attitudinal Questions	**Baseline**	**Follow-Up**
	%	%
Little	7	3
How important is it for your organization to save water?		
Very Important	50	42
Somewhat Important	31	31
Not Important	19	28
How much water could your organization save?		
Save no more	47	32
Save 1-5%	38	46
Save more than 5%	15	22
Would you save for salmon?		
Very Likely	55	39
Would you save for the environment?		
Very Likely	66	45
Would you save to save on water and sewer bills?		
Very Likely	60	34
Would you save to delay development of costly new supplies?		
Very Likely	58	26
Which of these four reasons is most important?		
Money	30	44
Environment	50	27
Delay costly new supplies	15	19
Salmon	5	8
None of above	1	2
Overall Weighted N Notes: Ns may vary by question due to missing data. Percentages many not total 100% due to rounding.	22405	22405

say they can save more in 2002 compared to 53% in 2001. (This could reflect the general drought alert messaging that emphasized what customers could do to save.)

When asked a series of questions about what could motivate them to save water, more shifts appeared – primarily away from environmental reasons (including salmon) and toward financial savings, perhaps reflecting tougher economic times. Finally, maintenance issues may be an important motivation not addressed by this set of questions, but it certainly emerged as a consideration among many that had taken action.

6.2.4 Awareness of, Participation In, and Interest in Water Smart Technology

Tracking the change in awareness of the program is somewhat compromised by a design that revisits the same organizations where respondents were asked about their awareness of the program in the prior year: one would expect an inflated response. Thus, as shown in Table 19, the overall rise from 24% to 40% awareness of a conservation program for commercial customers is probably high unless the program undertook a prominent and broad effort to publicize itself in the prior year. (Program managers report the marketing was very targeted.).

When the awareness level is calculated for new or old respondents only, the proportion drops to 32% for new respondents and rises to 43% for old respondents (indicating the effect of the prior survey). This

proportion is probably closer to reality, and indicates little change in overall customer awareness has taken place over the past year. This is supported by subsequent questions showing that very few organizations know the name of the program unaided, and less than a quarter remember the name when it is given. About 2% in the follow-up survey reported they had participated in WST in 2001; notably, half of these organizations also had participated in the program in other years.

Although general awareness did not change overall, significant increases in general awareness did occur for large customers, hotels, and medical facilities – three segments targeted by the program. Awareness levels, however, did not change or decreased for two other targeted segments: awareness among restaurants was unchanged at about 45% and awareness at educational facilities decreased from 61% to 42%.

Table 19: Awareness of and Participation in WST

Awareness of WST	**Baseline**	**Follow-Up**
	%	%
Heard about a water conservation program for commercial customers?		
(all respondents) Yes	24	40
(new respondents only)Yes	NA	32
(repeat respondents only) Yes	NA	43
If Yes, do you know the program name?		
Yes	6	<1
% of all respondents	1	<1
Aided recall of program name (by those aware of a commercial program)		
Yes	19	27
% of all respondents	4	13
Participation in WST during 2001		
	NA	2
Prior completed project through WST?		
	NA	2
Past involvement with a utility program?		
	6	NA
Overall Weighted N Notes: Ns may vary by question due to missing data. Percentages many not total 100% due to rounding.	22405	22405

Respondents to both surveys were asked how interested they were in knowing more about the program. Some shifts occurred between the baseline and follow-up surveys. Overall, fewer customers in the follow-up survey were very interested in knowing more about the program, but more were somewhat interested, and fewer had no interest, as shown in Table 20.

When these ratings are cross-tabulated with other descriptive variables, this profile emerges of the types of organizations that are most interested in more information about the program:

- Large and very large use customers (60-70% very interested). Strong interest is much lower among organizations with smaller use.

- Organizations that own their buildings

- Organizations with multiple buildings, large floor area, and higher water costs

- Organizations that report their largest uses are food service, industrial processes, laundries, and outdoor cleaning. This dovetails with quite well with type of business: more than 30% of educational facilities, hotels, restaurants, mixed use buildings, and medical facilities report they are very interested, and 20% of manufacturers are also very interested.

Table 20: Interest in Knowing More About WST

	Baseline	**Follow-Up**
	%	%
Very Interested	29	20
Somewhat Interested	31	37
Not Too Interested	19	43
Not At All Interested	21	<1
N	22405	22405

Thus, opportunity for savings still exists among the five current target markets and two additional target markets: manufacturers and mixed-use buildings. Organizations within all these segments are the most likely to be very interested in participating.

When asked what major barriers their organization faced in participating, the largest portion of organizations in the baseline survey said they had "nothing to save" (47%) This barrier declined significantly to 6% in the follow-up survey, although 26% in the follow-up said they had "done everything" which is likely a more acceptable way to say the same thing. Still, the data suggest that at least half of customers do have opportunities to save and that the opportunities are likely to be substantial among those most interested in the program (i.e., witness the interest of large consumers and various business types such as educational institutions).

The percentages for other types of barriers varied greatly between the baseline and follow up, but the list included:

- Money (up significantly from 3% in the baseline to 20% in the follow-up, another indication of changes in the economy)
- User behavior or regulations (often felt to be out of their control)
- Technical requirements
- Lack of time
- Lack of information
- The "bureaucracy"

Finally, customers were asked about the advice they would give their water utility for working with commercial organizations to achieve water savings. Many had no advice to offer (around 40%). In the baseline survey, the strongest advice was to "publicize the program" and to give better information. In the follow-up survey, less emphasis was placed upon publicizing the program but more on giving better information (this may reflect more of them being aware because of the prior survey contact. A notable type of advice in the follow-up survey did not appear in the baseline: manage the utility better. These comments probably stem from perceptions about handling of the drought and rate increases for residential customers after the drought alert.

7 Strategies for Improving the Program

We recommend that SPU adopt the following strategies to improve this program:

- To improve the gross savings realization rate, verify water savings for all measures estimated to have savings greater than 1,000 CCF/yr. The verification would include baseline measurements in all cases and post-installation measurements, when appropriate. In the 2001 program, 26% of the measures met this criterion and they accounted for 83% of the program staff estimate of savings for the program. All or a portion of the incentive should be dependent upon the results of the verification.
- To reduce errors in the program-tracking database, redesign the form used to document savings from approved customer applications. This form should require separate estimates of savings for each distinct measure covered by the applications. The form should also standardize the units for the final savings number, e.g., GPD or CCF/yr. Improved quality control procedures for the entry of the measure savings into the program-tracking database would be helpful. Specifically, have two people independently check each entry.
- Create a written log of interactions between customers and SPU program staff after a customer expresses interest in program participation. This log should clearly document all interactions that the program has with the customer regarding water conservation actions in both the short term and long term. This log will create a customer history that will be very helpful to both future marketing efforts and program evaluations.
- Review the savings calculation methodologies being used by the program, in light of program evaluation results. Update the methodologies to reflect the measured results and analysis methods, with particular attention to measures with low realization rates.
- To reduce free-ridership:
  - Ask customers to verify that they have not placed an order or received any of the parts or equipment needed to implement a proposed measure. Make it a clear qualification requirement, i.e., in marketing materials, workshops with customers, and with vendors, that such ordering or receipt not take place prior to approval of the customer's application for an incentive.
  - Work with vendors to determine how to increase use of the program as an up-front sales tool rather than as a "bonus" after the buyer has already decided to buy the same product.
  - Do not fund measures with less than an 18-month payback, considering water cost savings.
- Consider lowering incentives to stretch program dollars, since for 80% of the 25 measures, participants would have still gone forward if the incentive had been cut in half. Although the numbers are small by type of measure, lower incentives would have worked for all low-flow toilets (3 of 3) and urinals (2 of 2); irrigation control systems (2 of 2); water pumps (2 of 2); ozone laundry systems (2 of 2); and the cooling system (2 of 2). Lower incentives would also have been acceptable for 3 of 5 air-cooled ice machines.
- Develop a written set of goals and objectives for program performance aside from savings impacts. Then develop a set of measurable indicators to track progress. For the program, indicators might specify goals for participant satisfaction; level of vendor involvement in program promotion; level of strategic partnerships; evidence of effective target marketing; and service to purveyor areas. For the overall customer population, indicators might include evidence of changes in customer knowledge and awareness of the program; attitudes about conservation; and conservation actions taken.

- Where needed, expand process evaluation efforts to address the indicators adopted. For instance, if vendor and trade partnerships are central strategies to program success, include interviews with key partners or a survey of appropriate vendors. Use these findings to better understand and improve vendor involvement and trade partnership relationships.
- Expand success indicators to include lower levels of free-ridership; changes in customer behavior (spillover); and increased market share of water efficient equipment.
- If not currently being done, gather marketing information through the program application or initial contact with the customer and include it in the program database. This data can then be accessed for evaluation purposes. Items to include are the organization's market segment (note: codes need to correspond to defined targets such as hospitality, medical); how the applicant found out about the program; and whether or not a vendor was involved.
- Continue marketing to current market segments, but improve or increase efforts for restaurants and educational institutions, e.g., primary and high schools, and add manufacturing and mixed-use buildings as specific targets. Give more emphasis to the program name so that customers have a "short-hand" reference to the program and can pass it along to other organizations.

8 Strategies for Future Program Evaluation

We recommend that SPU conduct future evaluations of this program by conducting the following studies:

- **Marketing Allies**. Every three years, assess the current role and potential contribution to the program, for a sample of marketing allies. These should include representative vendors for all water efficiency technologies, trade associations and other entities that SPU relies on to market the program.
- **New Technology**. On an on-going basis, perform engineering data collection and analysis for the first three installations of each new water savings technology. These evaluations should be used in developing the methodology for program staff estimates of water savings for these new technologies.
- **High Uncertainty Measures**. In 2003, perform engineering data collection and analysis for additional samples needed to reduce uncertainty in realization rate estimates. This should be repeated periodically, on an as-need basis, in subsequent years.
- **Net Realization Rates**. On an annual basis, conduct decision-maker interviews with samples of program participants to evaluate free-ridership and spillover effects. When decision-makers report that their actions were influenced by a vendor's recommendation, interview the vendor to determine whether the program influenced the vendor's recommendation and incorporate this information in the free-ridership and spillover scoring.
- **Impact Evaluation**. In 2007 (or sooner if there are major changes to the program), perform engineering data collection and analysis for a representative sample of all water efficiency technologies to determine gross realization rates and program savings. The analysis of water savings should also include significant spillover measures.
- **Savings Outside the Rebate Program**. In 2003 and 2008, conduct decision-maker case studies and engineering analyses of measures installed outside the incentive program. The engineering analyses should quantify the savings from measures installed outside the program. The decision-maker case studies should confirm what factors contributed to the decision to install these measures and to what extent the SPU program had an influence on these decisions. In 2002, select the sample for this study from the 78 decision-makers who report installing measures outside program in the population baseline/follow-up surveys. In 2007, find these decision-makers from surveys of random samples selected from a new population sample frame.
- **New Customers**. In 2003 and 2008, conduct decision-maker case studies and engineering analyses of customers who have substantial water use but who have not taken any action to save water, either inside or outside the program. The engineering analyses should determine whether these customers have any potential for water savings. The decision-maker case studies should determine what would be required to motivate these customers to take actions in the future. In 2002, select the sample for this study from decision-makers who reported not taking any water savings actions in the population baseline/follow-up surveys. In 2007, find these decision-makers from surveys of random samples selected from a new population sample frame.
- **Savings Persistence**. In 2003 and 2008, conduct inspections of representative samples of measures to determine whether the measures are still in-place and operating. The sample should emphasize measures that involve controls or can be easily disabled by the customer. Special emphasis should be placed on measures that have been replaced. In cases where program measures have been replaced with less efficient equipment, an attempt should be made to quantify the degradation in savings. The sample for 2003 should be drawn from measures installed at least five years ago. The 2008 study should be a sample of measures investigated in

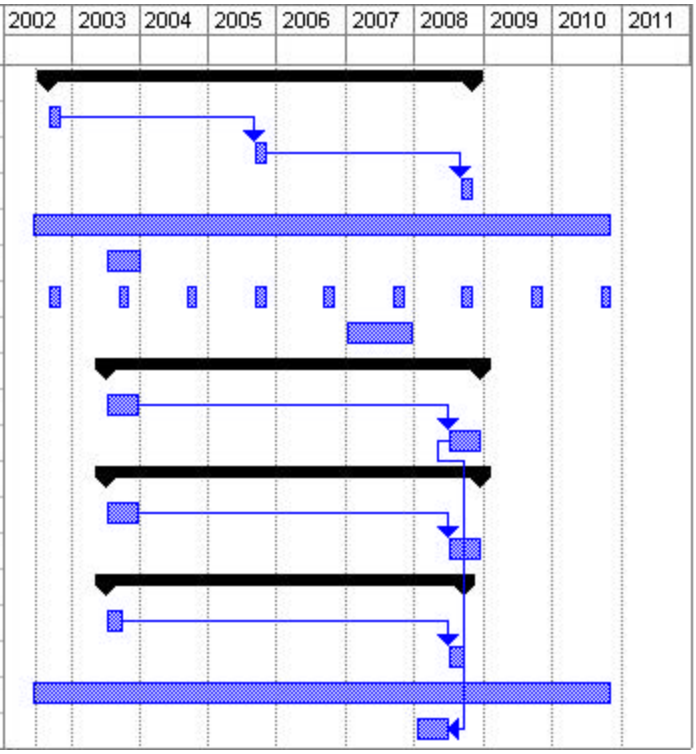
2001 and 2002.

- **Customer Satisfaction**. Design and implement a customer mail survey that will detect major customer service problems for the program. These surveys would be mailed to all customers approximately three months after they receive an incentive payment.
- **Population Sample Frame**. In 2007, develop a list of all commercial and industrial meters served by SPU and its purveyors, including service address, account name and annual water use. Draw a large random sample of these meters; determine what customer each meter belongs to and associate customer-level contact information with each meter.

The timeline for conducting these studies over the expected life of this program is shown in the figure below.

Figure 1: Timeline for Future Evaluations

ID	Task Name
1	**Marketing Allies**
2	Study #1
3	Study #2
4	Study #3
5	New Technology
6	High Uncertainty Measures
7	**Net Realization Rates**
17	Gross Realization Rates
18	**Savings Outside the Program**
19	Study # 1
20	Study # 2
21	**New Customers**
22	Study # 1
23	Study # 2
24	**Savings Persistence**
25	Study # 1
26	Study # 2
27	Customer Satisfaction
28	Population Sample Frame



9 Cost-Effectiveness (This chapter written by SPU staff)

Below are draft levelized costs for each measure group based on expenditures for all 2001 projects. These costs incorporate net present value of project cost and an approximate allocation of program costs for administration, promotion and technical assistance. Levelized costs should not exceed $1.89/ccf to be cost-effective relative to future supply opportunities.

Evaluation Category	**Levelized cost ($/ccf)***
All Process	$0.58
Washing machines	$1.89
Refrig / ice machines	$1.39
Other single-pass	$1.51
Process water	$1.66
Cooling tower	$0.04
Other technology	$0.71
All Domestic	$1.13
Tank type toilets	$1.43
Flush valves toilets	$1.76
Urinals	$0.68
Irrigation	$0.87
All commercial total	$0.90